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MOBILE WATER TREATMENT PLANT TESTING AT THE OBED WASHERY: JUNE - DECEMBER, 1985

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by

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ABSTRACT

The experimental work was performed on both bench scale and pilot scale; the latter utilizing the Coal Research Laboratories mobile water treatment plant. The purpose of this test work was to evaluate the performance of five flocculants (supplied by Obed Mountain Coal Company Ltd.).

When rating of the flocculants is based solely on performance criteria, Diachem (4421 and 2890) is ranked first followed by Hart CFA 30 plus Alchem 8852. Rating based on cost-performance is not the same; Calgon (M502 and L691E) is ranked as first, followed by Diachem (4421 and 2890).

The monitoring of washery flocculant consumption has indicated that Alchem 8852 and 8C26 usage is high; anionic dosage varied from 31 to 311 gram per tonne of clean coal and cationic dosage varied from 95 to 242 gram per tonne of clean coal. This amounts to 35 -90¢ per tonne of clean coal.

It is recommended that further field testing, aimed at optimizing the operation of the thickener with first and second ranking flocculants be conducted to further reduce the flocculant consumption.

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INTRODUCTION

Coal washing produces effluents containing fine coal, clay, shale particles, and other solid matter. The volume of the effluent produced depends on the washery capacity and the type of beneficiation methods employed. A typical western Canadian washery produces up to 3000 L of effluent per tonne of coal processed.

The importance of treating the effluent has gradually increased and today accounts for a significant portion of total processing cost. Under present economic conditions, it is imperative that the wash plants become more efficient and minimize operating costs. During 1983, the costs associated with treatment of effluents were conservatively estimated at \$2.6M, the reagent (flocculant) costs accounting for \$1.5M of this total.

There are several ways to evaluate the performance of the flocculant, depending on the end uses of the process. Some of the performance criteria are the settling rate of the flocculated solids, clarity of the supernatant, volume of settled solids, filterability of flocculated solids, residual moisture in filter cake, etc. In a processes such as municipal water treatment water clarity would be of primary importance, whereas in a mineral processing plant a high settling rate may be the major objective.

In order to characterize the flocculation behaviour of the slurries and to identify proper operating conditions, both bench scale and pilot scale tests should be carried out prior to plant test trials. In bench scale testing, flocculation is carried out under very well controlled conditions; results obtained reflect the flocculation characteristics of the sample with a particular flocculant. Thus the bench scale test results serve as a guideline for screening and ranking of pre-selected flocculants. The bench scale results also determine optimum dosage. The optimum dosage may be defined as the dosage which yields the best performance criteria. The flocculants and the dosages recommended by the bench testing will then be tested at pilot scale by utilizing the mobile water treatment plant. The pilot scale tests are conducted under actual plant operating conditions using a portion of the washery effluent stream without any interruption in the full scale plant operation.

The Fuel Processing Laboratory (FPL) Edmonton was approached by the Obed Mountain Coal Company to assist in the selection of suitable flocculants for their water treatment circuit. The washery requested that flocculants from five suppliers (Allied Colloids, Alchem, Calgon, Hart, and Diachem) be included in the evaluation. The Alchem flocculants (8C26 and 8852) were in use in the washery at the time of the testing. The test work included a performance evaluation of the supplied flocculants on both bench scale and pilot scale utilizing the FPL mobile water treatment plant. The mobile plant includes a 2.44m diameter thickener and appropriate auxiliary equipment. The mobile plant is designed to handle up to 45 m^3/h.

EXPERIMENTAL WORK PLAN

The experimental work plan included the following:

1. Laboratory Testing

    (a) To characterize the washery thickener feed samples.
    (b) To determine the optimum dosage of the flocculants.
    (c) To evaluate the performance of the flocculants.

2. Field Testing

    (a) To evaluate the performance of the flocculants and rank them on cost and performance basis.
    (b) To monitor the performance of the washery thickeners.
    (c) To monitor the consumption of flocculants.

Table 1 **Experimental Design: To evaluate the performance of the flocculants at pilot scale**

Order	Cation + Anion			Anion + Cation		
Dosage Flocculant	Low	Med	High	Low	Med	High
Alchem						
Allied Colloids						
Hart						
Diachem						
Calgon						

Order: Order of flocculant addition

Dosage: Flocculant dosages
Low = 1/2 of the bench scale optimum dosages.
Med = Same as the bench scale optimum dosages.
High = Twice the bench scale optimum dosages.

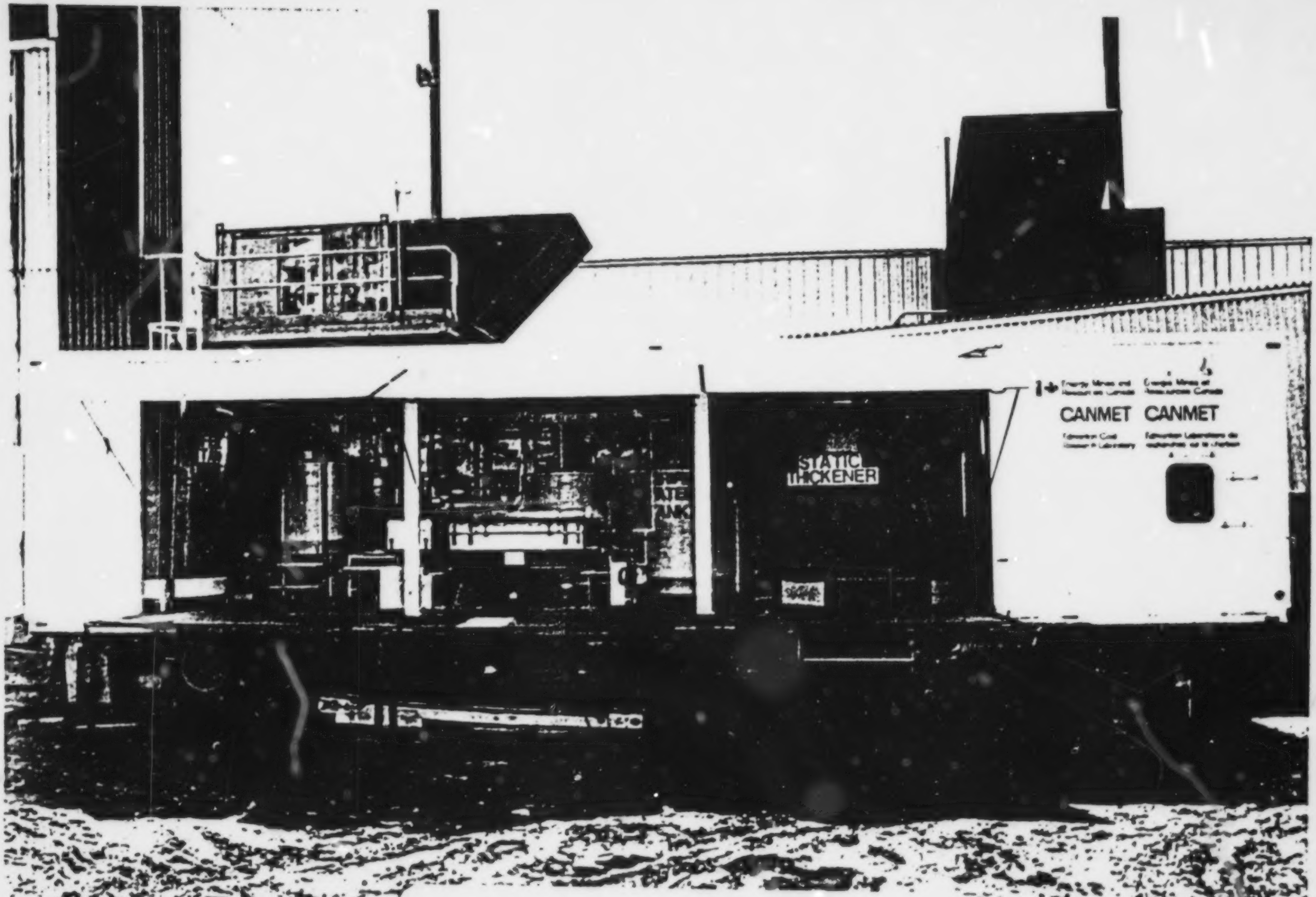

Figure 1

Mobile Water (Effluent) Treatment Plant

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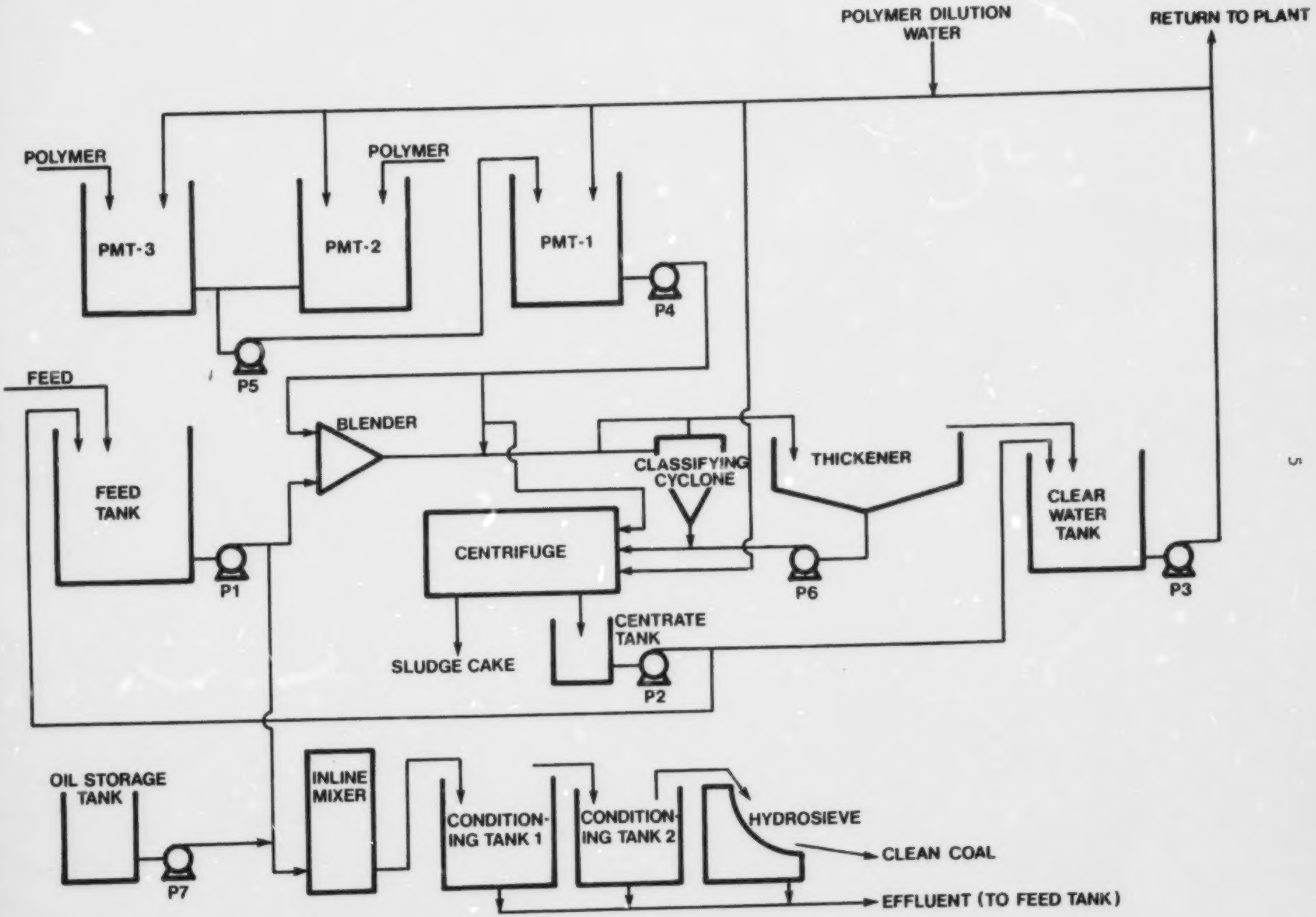


Figure 2 - **MOBILE WATER TREATMENT PLANT - FLOW SHEET**

EXPERIMENTAL PROCEDURE

1. Laboratory Testing

(a) Materials

Two five-gallon samples were received from Obed washery; they were high ash thickener feed and process water. The solid content, pH, proximate analysis, screen size analysis and sub-sieve size analysis using Coulter Counter were performed. Results are shown in Table 2.

Nine flocculants of different ionic charges were used in this study. They were Alchem 8852 and 8C26, Calgon M502 and L691E, Allied Colloids Percol E-10 and LT31, Diachem 4421 and 2890, and Hart Crossfloc CFA30.

(b) Procedure:

(i) Cylinder Test:

Settling rates of the slurry were determined using 100 ml glass graduated cylinders equipped with stoppers. A 0.2% flocculant solution of each polymer was prepared by dissolving it in process water. In a single polymer application, flocculant solution was added in small incremental dosage to determine optimum dosage. In dual flocculant (cationic and anionic) application a fixed volume of the first flocculant solution (optimum dosage) was added first, followed by incremental addition of the second flocculant solution to determine optimum dosage. After the addition of the first flocculant, the cylinder was inverted five times to ensure proper mixing. The cylinder was then allowed to stand undisturbed and the rate of settling of the slurry/supernatant interface was determined.

(ii) Beaker Test:

A sample (20 ml) of the slurry was poured into a 50 ml beaker and the height of the suspension was recorded. A known dosage of a flocculant was added and the mixture was stirred manually with a glass rod (constant stirring time throughout). The height of the

TABLE 2: Characteristics of the thickener feed sample.

a) pH and % Total solids

sample	pH	% Total solids
1. Thickener feed	8.51	3.33
2. Process water	8.21	0.04

b) Size Analysis

Screen size (micron)	Wt. of each size fraction (gms)	Wt. % of each size fraction
+ 600	0.02	0.05
600 x 250	0.13	0.33
250 x 150	0.19	0.49
150 x 75	2.46	6.29
75 x 45	3.48	8.89
- 45	32.85	83.95

Coulter Counter Analysis of -45 µm fraction
Mean Particle Size = 7.56 µm.

c) Proximate Analysis

screen size (µm)	% moisture	% volatiles	% ash	fixed carbon
+ 75	7.39	30.82	15.18	46.61
75 x 45	8.76	21.40	44.96	24.88
- 45	11.98	11.80	71.30	4.92

sediment and the clarity of the supernatant were recorded at different time intervals up to 30 minutes. This beaker test provide a preliminary screening of the flocculants and require much less volume of sample as compared to the above cylinder test.

2. Field Testing

The feed to the mobile plant was obtained by taking a side stream from the washery high ash thickener feed line (prior to any flocculant addition). The thickener feed from the washery was continuously fed by gravity into a (4.54 m^3) feed tank where it was continuously agitated. From the feed tank it was fed to the mobile plant thickener by a variable speed slurry pump. The feed rate was set at 27 m^3/h (100 gpm). The flocculant solution was prepared in flocculant tanks, PMT's 1-3, by adding a known amount of powder or liquid flocculant to a fixed volume of water. The dissolution of powder flocculant was achieved with a 2-stage atomizer in which flocculant falls by gravity through a high energy zone generated by water flowing through an annular venturi. The flocculant solution was allowed to mix at a slow speed for about 20 minutes before mixing with the slurry. In a single flocculant application the flocculant was added in-line, about 10 m upstream from the thickener feed well. In dual flocculant application [cationic and anionic]; one type was added in-line and the second type was added at the feed well.

Before each test the flocculant addition rate was adjusted according to the experimental design conditions. The thickener was filled with the feed and flocculant simultaneously. Upon filling the thickener, the underflow pump was activated and the pumping rate was adjusted at 65 kg/min by a variable speed controller. The feed flow rate was monitored by a magnetic flow meter (Mini-Mag) and the thickener underflow was monitored by a mass flowmeter (Micromotion). The flocculant addition rate was set by adjusting the speed of positive displacement Moyno pumps. All the pumps and flowmeters are normally interfaced with a computer monitoring system (HP 3497 Data Acquisition System). Unfortunately, operation of this system was not possible in this study because of the data logger tripping out due to some washery equipment vibrations and power fluctuations.

The overflow and underflow samples were monitored at 5 minute intervals for the duration of the test. The underflow solids content was monitored using a Marcy scale while the overflow clarity was monitored using a clarity wedge. One-litre samples of feed, underflow and overflow were collected every 15 minutes. In addition, a 5-litre sample of the feed was collected for size analysis at least twice during the test run.

RESULTS AND DISCUSSION

1. Bench Scale

Most of the data obtained from bench scale testing are in terms of sedimentation rate measured in 100 ml glass stoppered graduated cylinders, and clarity of the supernatant.

Figures 1 to 2 in Appendix C illustrate the effects of various anionic and cationic polymers by itself on a given sample. Results indicate that the anionic polymers give faster settling rates than the cationic polymers.

Figure 3 in Appendix C illustrates the sedimentation rate (initial settling rate) vs. concentration of polymer in dual application. In this case, a fixed amount of cationic polymer was added first followed by the incremental addition of the anionic polymer. Among all the combinations, Alchem 8852 plus Hart Crossfloc CFA30 and Alchem flocculants (8852 + 8C26) yielded the fastest settling rate and best clarity.

Figure 4 in Appendix C illustrates the sedimentation rate (initial settling rate) of another case of dual polymer application in which a fixed amount of anionic polymer was added first followed by the incremental addition of cationic polymer. From these curves it can be shown that 8852 plus 8852 gave the best results followed by Calgon L691E plus M502. The performance data of all the flocculants is listed in Table 3. Pictures of the bench scale settling rates tests are included in appendix E.

TABLE 3: Performance Data of Various Flocculants - Bench Scale

Flocculants	Price* $ /kg	Optimum dosage		Clarity [wedge]	Settling rate (m/h)
		kg/t	¢/t		
Alchem					
Cation (8852)	1.60	0.0290	4.64	9	0.09
Anion (8C26)	2.90	0.1162	33.70	19	6.52
Cation + Anion		0.0145(C) 0.1162(A)	36.02	28	6.52
Anion + Cation			36.02	30	3.96
Calgon					
Cation (M502)	1.49	0.0290	4.32	30	0.05
Anion (L691E)	2.80	0.2324	65.07	15	3.89
Cation + Anion		0.0145(C) 0.1162(A)	34.70	30	1.09
Anion + Cation			34.70	25	2.00
Diachem					
Cation (4421)	1.55	0.2324	36.02	30	0.03
Anion (2890)	2.99	0.2324	69.49	30	6.52
Cation + Anion		0.0058(C) 0.0872(A)	26.97	30	1.88
Anion + Cation		0.1162(A) 0.0145(C)	22.35	30	1.18
Allied Colloids					
Cation [LT31]	1.78	0.0290	5.16	24	0.05
Anion [E10]	3.08	0.2324	71.58	30	6.52
Cation + Anion		0.0145(C)	38.37	30	0.63
Anion + Cation		0.1162(A)	38.37	30	1.68
Hart & Alchem					
Cation (8852)	1.60	0.0290	4.64	9	0.09
Anion (CFA 30)	2.95	0.0324	68.56	30	6.52
Cation + Anion		0.0145(C)	36.60	30	4.92
Anion + Cation		0.1162(A)	36.60	30	1.70

* based on truck load, 20,000 bl. F.O.B. washery.

2. Field Testing

(a) Allied Colloids Flocculants

Seven tests were conducted with Allied Colloids flocculants; Percol E10 (anionic) and Percol LT31 (cationic). Details of the tests are presented in Appendix A which include (1) test duration, (2) order of flocculant addition, (3) ratio of flocculant dosages with respect to the bench scale optimum dosages, and (4) the flocculant dosages. The flocculant cost and analysis of feed, overflow and underflow are presented in Table 4. The tables also contain initial, final and average values of overflow clarity and underflow solids concentration. The initial value is reading at the beginning of a test run, the final value is taken when steady state conditions are reached, and the average value is a calculated average of a test run.

As shown from the bench testwork, Percol E10 by itself gave good clarity (30 wedge reading) and fast settling (6.52 m/h). The first field test (P10) was conducted using only Percol E10. As shown in the test details table (Appendix A), the test started by adding half of the optimum dosage and subsequently increased to twice the optimum dosage. The results showed zero clarity and low solids concentration in the underflow. Due to these poor results no further tests were conducted with Percol E10 only. The second test (P2) was conducted using both anionic and cationic flocculants; Percol LT31 was added first and then Percol E10. This test was started with dosages equivalent to the bench scale optimums and after 45 minutes the dosages were doubled. By increasing the dosages, the overflow clarity improved from 3 to 7 but no improvement was shown in the underflow concentration. This test (P2) was stopped at 105 minutes (due to stoppage in the feed supply) and continued the next day as test (P5). The results with the initial dosages showed poor clarity (4 wedge reading) and a better underflow (19.82% solids - final reading). After 40 minutes, the flocculant dosages were increased to approximately 3 times the bench scale dosages. With this increase, the results were substantially improve, the overflow clarity reached 46 and the underflow solids content 29.63%. This test was discontinued after 2 hours due to feed interruption from the washery. The test (P5) was continued next day as test (P6) and was conducted for about 4 hours. The results from this test showed similarity to the previous test (P5);

the overflow clarity reached 46 and the underflow concentration 25.18%. A set of 5 photographs (Figure 3) shows the product streams as the test progresses. The clarification and thickening results from test P1, P2, P5 and P6 are plotted in Figures 5 and 6 respectively in Appendix C.

The tests P3, P4 and P7 were conducted by reversing the order of flocculant addition (anion plus cation). The difference between tests P2 and P3 is that order of flocculant addition the anionic flocculant was added first followed by the cationic. The clarification in this case improved from 7 to 9, however, no significant difference in the concentration of underflow was observed. The test P3 was discontinued (at 100 minutes) due to stoppage in the feed supply. After an hour the testing was resumed, test P4 being a continuation of P3. The flocculant feed rates were kept the same as in test P3, but due to a decrease in feed solids the actual flocculant dosages, based on 4% of solids in the feed, were increased by approximately 10%. The results showed an excellent overflow clarity (46-final) and underflow solids concentration (21.02% - final). Again there was a problem in the washery and the test was stopped at 125 minutes. The test was continued the next week as test P7, the test conditions were kept the same as in test P4 but due to increase in feed solids the flocculant dosages were increased by approximately 5%. The results showed similarity in the overflow clarity and improved underflow solids concentration (see Table 3). The clarification and thickening results are plotted in Figures 7 and 8 respectively in Appendix C.

(b) Hart-Alchem Flocculants

Six tests were conducted using Crossfloc CFA-30 (anionic-Hart) and Alchem 8852 (cationic-Alchem). In tests H1, H3 and H5 the cationic flocculant was added first followed by the anionic flocculant. In the remaining tests (H2, H4 and H6) the order of flocculant addition was reversed (anionic then cationic). The first test (H1) was conducted for about 220 minutes, the flocculant dosages were varied from 0.5 to 2 times the respective bench scale optimum dosages. With increasing flocculant dosages, the overflow wedge clarity reached the maximum of 22 and the underflow solids concentration reached as high as 37.55% (see the laboratory analysis in Appendix B). Test H1 was discontinued at 220 minutes upon noticing no further improvement in the quality of the overflow and the underflow. In test H1, best results were obtained when the dosage of CFA-30 was the same as the bench scale optimum and the dosage of 8852 was half of the bench scale optimum. Test H3 was conducted using the best dosages determined in test H1. The results obtained showed good concentration in the underflow solids (27.89%) and zero overflow clarity. The test was continued for about 100 minutes by increasing the cationic flocculant dosages from 5.13 to 10.72 g/t. With this increase the overflow clarity was improved from 11 to 25 (final). Meanwhile the underflow solids concentration was increased from 19.58 to 29.59%. The subsequent test (H5) was conducted with the above determined dosages. The results showed similarity in the overflow clarity and a reduction in the underflow solids concentration. The results are shown in Table 5. The clarification and thickening results are shown in Figures 9 and 10 respectively in Appendix C.

Tests H2, H4 and H6 were conducted with Crossfloc CFA-30 added first and then Alchem 8852. Test H2 was conducted for about 210 minutes. With increasing flocculant dosages, the overflow clarity reached 46 and the underflow concentration reached a maximum of 35.0% (see Appendix B)with an average of 26.07%. Tests H4 and H6 were conducted using the aimed flocculant dosages. The results obtained were comparable in clarification (See Appendix F - Thickener performance data). The underflow concentration obtained in test H4 (26.78% - final) was much better than in test H6 (11.30% - final).

(c) Diachem Flocculants

Six tests were conducted with the Diachem flocculants; 2890 (anionic) and 4421 (cationic). The first test (D1) was conducted with only the anionic flocculant; the dosages were varied from 220.20 to 528.18 g/t. With increasing flocculant dosages the overflow clarity was increased to 46 and the underflow solids concentration was also improved (25 - 30%) which is at an acceptable level. Generally, anionic flocculants gave good thickening and poor clarity while the cationic flocculants gave good clarification and poor thickening.

The second test (D2) was conducted with only cationic flocculant (4421). Excellent clarity was obtained but again the underflow solids concentration was poor. The results of this test are shown in Table 6. The clarification and thickening data are plotted in Figures 13 and 14 (Appendix C).

In the remaining tests (D3-D6) both flocculants (2890 and 4421) were used. In the test D3 and D4, the cationic flocculant was added first followed by the anionic flocculant; in tests D5 and D6, the order of flocculant addition was reversed. In test D3 the flocculant dosage was gradually increased from 0.5 to 1.5 times the bench scale optimum dosage. The maximum dosage gave the best results (clarity of 46 and underflow concentration of 31% solids). The next test (D4) was conducted with the maximum dosages from the previous test but due to a higher solids content in the feed, the actual dosages were decreased by 17% as shown in the test details (see Appendix A). With these dosages, excellent clarity (46 wedge clarity) was obtained but the underflow concentration was decreased from 31.34% to 17.48%.

In test D5 the cationic flocculant dosage was kept at half of the bench scale optimum, and the anionic flocculant dosage was increased from 0.15 to 1.25 times the bench scale optimum. The actual dosage was lower than the dosage aimed for; this is mainly due to increase in the feed solids concentration from 4% (assumed value) to as high as 5.33%. With these dosages excellent clarity was obtained but poor underflow solids concentration. Test (D5) was discontinued due to interruption in feed supply (the washery was down). This test was continued next day as test D6. Excellent overflow clarity was obtained and the best underflow solids concentration (20.16%) was obtained towards the end of the test (see Appendix-B - laboratory analysis). The results are summarized in Table 6; clarification and thickening data is plotted in Figures 15 - 18 (Appendix C).

(d) Calgon Flocculants

Six tests were conducted using the Calgon flocculants M502 and L691E. In the first three tests C1 - C3 cationic flocculant M502 was added first; followed by the anionic flocculant 691E. The first test C1 was conducted using approximately half of the bench scale optimum dosages. A reasonable overflow clarity (24-wedge reading) and underflow solids concentration (17%) was obtained. Due to frequent interruptions in the feed supply, the test was discontinued at 95 minutes. The testing was resumed as test C2, the flocculant dosages were increased to the same level as the bench scale dosages. Due to low solids in the feed, the actual flocculant dosages were approximately 16% higher than aimed for. Compared to test C1, the underflow solids concentration was improved from 19.35 to 22.30% (average values), but no improvement was seen in the overflow clarity. Again, this test was also discontinued at 95 minutes for the same reasons. See the thickener data sheets (Appendix F) for the frequency of interruptions in the feed supply and general comments. In the next test C3 the flocculant dosages aimed at were twice the bench scale optimums. Due to lower solids in the feed the actual flocculant dosages were higher, i.e 28.10 vs 40.14 g/t (cationic), and 232.40 vs 332.0 g/t (anionic). At these high dosages, the overflow clarity and the underflow solids concentration were both improved. The results are presented in Table 7.

Tests C4 - C6 were conducted by reversing the order of flocculant addition (anionic + cationic). The first test (C4) in this series was conducted using half of the bench scale dosages. The clarity of the overflow was similar to the previous tests but an improved and consistent quality of the underflow solids concentration was achieved (29.12% average value). In the next two tests (C5 and C6), the flocculant dosages were increased as shown in the test details (Appendix A). The results showed excellent overflow clarity reaching the maximum wedge reading of 46. The underflow solids concentration decreased from 27.15% to 16.93% (average values) as shown in Table 6. The clarification and thickening data for tests C1 - C6 are plotted in Figures 19 - 22 included in Appendix C.

(e) Alchem Flocculants

The Alchem 8852 (cationic) and 8C26 (anionic) flocculants were those in use in the Obed washery at the time of testing. Tests AA1 - AA3 were based on the optimum dosage determined by the cylinder settling rate procedure, and Tests A1 - A20 were based on the dosage from the beaker testing. The details are included in Appendix A. Test AA1 was conducted for 6 1/2 hours increasing the flocculant dosage from 0.5 to 2.5 times the bench scale optimum dosage; the flocculants were added in the order of cationic plus anionic. With increasing dosage, the overflow clarity was improved from 0 to 46 (maximum wedge clarity). The average underflow solids concentration was also increased from 11.50 to 23.88%. These results are presented in Table 8. The clarification and thickening data of tests AA1-AA3 are plotted in Figures 23 and 24 respectively (Appendix C). A set of 7 photographs (Figure 4) shows the quality of the overflow as the test progressed.

In the next test (AA2), the dosages which gave the best results in test AA1 (about 2.5 times the bench scale optimum) were used and the order of flocculant addition was also kept the same. The average overflow clarity decreased to 33 units and the average underflow solids concentration also decreased from 26.13% to 21.50%.

In test AA3, the order of flocculant addition was reversed (anionic + cationic). By increasing the dosage from 0.5 to 2 times the bench scale optimum, the overflow clarity and underflow solids concentration were both improved as shown in Table 8. However, the order of flocculant addition is important; the results have shown that cationic plus anionic gives better results.

In tests A1 to A4, only 8C26 (anionic) was used and the dosages ranged from 28.04 to 130.56 g/t. With increasing dosages, overflow clarity was increased from 5 to 22 units. Underflow solids concentration, however remained very low (4.06 - 6.37% average values). Figures 25 and 26 [Appendix C] show the clarification and thickening data, respectively.

In tests A5 to A8, both flocculants (8852 and 8C26) were used; the anionic was added first. With increasing dosages, the overflow clarity remained between 7 to 10 and the underflow solids concentration decreased from 21.15% to 14.50%. The clarification and thickening data of these tests is also shown in Figures 25 and 26 (Appendix C). In the remaining tests (A9 to A20), the order of flocculant addition was reversed (cationic + anionic). Tests A9 and A10 were conducted using a fixed dosage (4.88 g/t) of 8852 and the dosages of 8C26 were increased from 24.44 to 48.88 g/t. Due to some variations in the feed solids (3.59% in Test A9 and 4.11% in Test A10), the actual flocculant dosages were slightly different, and are reported in the test details (Appendix A). With increasing anionic dosage the overflow clarity was slightly improved (from 13 to 16 average value) with no improvement in the underflow solids concentration (See Table 8). Test A10 was discontinued due to stoppage in feed supply but was continued next day as test A11. The feed contained significantly less solids than in tests A9 and A10. The results showed an improvement in thickening (underflow solids concentration increased by 10 % - final values) and a reduction in clarification from 17 to 10 (final wedge clarity). Test A12 was conducted by increasing the dosage of 8852 from 4.88 to 7.32 g/t and the dosage of 8C26 was decreased from 48.88 to 24.44 g/t. Again there was a problem in the feed supply and this test was discontinued after 45 minutes. Similarly, the next two tests (A13 and A14) were discontinued (see thickener data sheet-Appendix F). Test A14 was repeated, as a result of poor flocculation overflow clarity of less than 5 and underflow solids concentration less than 8%. This test was continued, as test A15, by increasing the dosage of 8C26 from 24.44 to 48.88 g/t with the dosage of 8C26 remaining at 7.32 g/t. After about 15 minutes overflow clarity was improved from 5 to 10 and this further improved to 16 with no improvement in underflow solids concentration. Again there was a problem in the feed supply, therefore the testing was discontinued (see thickener data sheet - Appendix F). Later on, test A15 was repeated. The results showed no improvement in underflow solidsconcentration and overflow clarity was decreased from 16 to 6 (average values).

Tests A16 - A19 were conducted by increasing the dosages of 8C26 from 24.76 to 97.76 g/t with the dosage of 8852 remaining at 9.76 g/t. The gradual increase in the anionic flocculant dosages did not help to improve underflow solids concentration (see thickener data sheet - Appendix F). As shown in the thickener data sheet these tests were conducted for 230 minutes (continuous operation), overflow clarity reached 7 and underflow solids concentration reached a maximum of 8%. The test was interupted due to stoppage in the feed supply. After an hour, the testing was resumed with test A20 being a continuation of test A19. In test A20 both flocculant dosages were increased to twice the dosages in test A19. With the increased dosages, overflow clarity was improved from 7 to 20 and a maximum of 20.49% underflow solids concentration was reached.

TABLE 4: Mobile plant field testing results - Allied Colloids Flocculants

Test	P1			P2		P3		P4	P5		P6	P7
Date	850626			850920		850921		850921	850921		850922	850922
Time	1120			1645		1140		1215	1520		1210	1700
Duration (min)	0 - 45	45 - 90	90 - 145	0 - 45	45 - 105	0 - 45	45 - 100	0 - 125	0 - 40	40 - 120	0 - 225	0 - 80
Floc dosages (g/t)												
Cationic	------	------	------	13.27	23.97	13.36	26.24	28.86	32.04	45.08	31.24	28.64
Anionic	87.37	231.82	469.49	106.36	192.07	107.10	210.32	240.08	256.79	361.24	250.34	229.53
Floc. Cost (/t)	26.91	71.40	144.60	35.12	63.42	35.36	69.45	79.08	84.79	119.29	82.66	75.79
Feed												
Solids Content (%)	5.32	4.01	3.96	4.37	4.84	4.34	4.42	3.84	3.62	3.86	5.57	4.05
Minus 45 µm (%)	85.24	84.32	85.96	85.75	86.04	86.80	86.54	85.50	89.60	88.95	86.47	89.79
Mean Particle Size (µm)	17.00	18.00	18.20	17.30	17.20	17.00	18.70	18.10	15.80	16.40	17.65	15.50
Ash Content (%)	74.49	76.51	76.81	71.11	75.35	74.26	74.38	73.77	73.85	73.98	75.22	75.70
Overflow												
Wedge Clarity												
Initial	0	0	0	0	7	0	20	0	0	4	0	0
Final	0	0	0	7	8	20	20	46	4	46	46	46
Average	0	0	0	3	7	11	19	32	1	33	24	22
Underflow												
Solids Content (%)												
Initial	9.58	10.68	10.44	14.67	7.20	10.70	9.57	13.69	12.87	19.82	9.29	11.43
Final	10.68	10.78	10.51	7.20	8.36	9.57	11.37	21.02	19.82	29.63	25.18	29.11
Average	9.98	10.44	10.33	11.32	9.38	10.81	10.72	16.04	16.09	27.48	17.08	21.08
Ash Content (%)	75.49	76.51	76.36	64.50	71.84	75.11	75.25	71.89	75.34	75.62	74.28	75.14

TABLE 5: **Mobile plant field testing results-Hart [anionic] and Alchem [cationic] flocculants**

Test	H1					H2			H3		H4	H5	H6
Date	851009					851002			851210		851024	851024	851024
Time	1030					1330			1135		1430	1740	1915
Duration (min)	0 - 40	40 - 90	90-140	140-185	185-220	0 - 45	45-100	100-210	0 - 230	230-330	0 -150	0 - 80	0 - 80
Floc dosages (g/t)													
Cationic	5.18	5.11	5.39	11.44	26.36	5.81	11.84	22.27	5.13	10.72	22.92	11.84	27.75
Anionic	41.50	81.97	172.79	183.35	211.27	46.57	94.86	184.81	82.26	85.91	183.72	94.86	222.39
Floc. Cost (/t)	13.07	25.00	51.84	55.92	66.54	14.67	29.88	58.08	25.09	27.06	57.86	29.88	70.04
Feed													
Solids Content (%)	5.60	5.67	5.38	5.07	4.40	4.99	4.90	5.03	5.65	5.41	5.06	4.90	4.18
Minus 44 µm (%)	82.98	-----	82.38	83.03	-----	84.49	85.85	83.02	84.16	82.68	82.94	85.34	86.02
Mean Particle Size (µm)	18.40	-----	18.50	18.20	-----	18.00	16.90	18.50	18.23	19.10	18.10	16.90	17.90
Ash Content (%)	77.87	78.03	76.46	74.96	74.58	69.35	71.20	71.34	72.08	71.79	69.09	71.88	69.88
Overflow													
Wedge Clarity													
Initial	0	10	22	11	14	0	0	21	0	11	0	0	0
Final	10	22	11	14	18	0	21	46	11	25	30	24	35
Average	2	18	14	12	17	0	17	38	12	20	26	17	31
Underflow													
Solids Content (%)													
Initial	12.39	17.64	32.38	31.05	31.03	8.64	11.99	18.89	14.95	27.89	14.93	9.81	7.89
Final	17.64	32.38	31.05	31.03	32.20	11.99	18.89	31.94	27.89	29.76	26.78	20.95	11.30
Average	14.03	23.06	30.24	33.21	32.49	9.33	17.05	26.07	19.58	29.59	18.72	14.85	9.39
Ash Content (%)	76.25	77.53	77.82	77.49	77.09	70.17	70.60	72.53	73.61	74.68	69.83	70.93	69.86

TABLE 6: **Mobile plant field testing results - Diachem flocculants**

Test	D1			D2		D3			D4	D5				D6
Date	851124			851124		851125			851210	851210				851211
Time	1155			1635		1435			1155	1345				1000
Duration (min)	0 - 40	40 - 80	80-180	0 - 35	35-105	0 - 40	40-80	80 -125	0 - 135	0 - 45	45 - 90	90 -150	150-210	0 -150
Floc dosages (g/t)														
Cationic	------	------	------	206.58	380.98	3.60	7.12	12.21	10.12	6.90	6.16	5.98	5.44	7.36
Anionic	220.28	341.76	528.18	------	------	54.16	106.99	183.58	152.09	55.33	74.01	95.83	109.01	176.95
Floc. Cost (/t)	55.87	102.19	157.93	32.02	59.05	16.75	33.09	56.78	46.05	17.61	23.08	29.58	33.44	54.05
Feed														
Solids Content (%)	2.11	2.72	2.64	2.25	2.44	3.22	3.26	2.85	3.44	4.20	4.71	4.85	5.33	3.94
Minus 44μm (%)	89.58	90.59	90.24	86.94	88.65	84.45	81.49	86.77	85.81	87.06	85.86	-----	84.88	85.32
Mean Particle Size (μm)	15.3	15.3	15.0	17.4	16.3	18.4	20.0	-----	17.7	16.9	17.0	-----	18.2	17.8
Ash Content (%)	74.37	72.67	71.44	73.01	72.95	69.43	68.59	67.92	72.54	70.78	70.53	70.05	70.61	68.09
Overflow														
Wedge Clarity														
Initial	0	10	23	0	0	0	13	18	0	0	8	46	46	0
Final	10	23	46	0	46	13	18	46	46	8	46	46	46	46
Average	4	17	43	0	36	8	12	41	39	2	33	46	46	23
Underflow														
Solids Content (%)														
Initial	9.23	7.21	9.81	19.08	11.90	14.54	22.14	28.19	9.23	22.89	10.34	8.77	9.83	12.63
Final	7.21	9.81	11.80	11.90	17.27	22.14	28.19	35.43	16.59	10.34	8.77	9.83	14.04	20.16
Average	8.45	8.71	14.95	14.97	13.08	18.18	20.54	31.34	17.48	12.90	9.28	8.81	12.05	13.11
Ash Content (%)	71.80	71.93	71.82	70.79	70.92	69.74	69.17	69.41	71.83	69.25	68.91	69.64	69.10	71.42

TABLE 7: **Mobile plant field testing results - Calgon flocculants**

Test	C1	C2	C3	C4	C5	C6
Date	850923	850923	850924	850924	851006	851006
Time	1040	1435	1335	1815	1530	1835
Duration (min)	95	95	80	65	135	80
Floc dosages (g/t)						
Cationic	6.81	16.76	40.14	9.18	15.63	24.17
Anionic	54.55	134.33	332.00	73.54	125.28	199.91
Floc. Cost (/t)	16.29	40.11	98.94	29.96	37.41	59.58
Feed						
Solids Content (%)	4.26	3.46	2.80	3.16	3.71	4.65
Ash Content (%)	70.20	77.45	70.81	70.76	72.03	----
Minus 44 μm (%)	81.85	80.93	82.39	82.69	82.22	87.50
Mean Particle Size (μm)	18.90	20.00	19.60	19.00	19.10	16.80
Overflow						
Wedge Clarity						
Initial	0	0	5	0	0	0
Final	24	22	27	22	46	46
Average	14	16	20	15	25	30
Underflow						
Solids Content (%)						
Initial	12.47	14.22	15.63	30.24	18.18	13.12
Final	17.46	20.49	25.90	29.29	28.24	16.44
Average	19.35	22.30	27.83	29.12	27.15	16.93
Ash Content (%)	70.77	73.51	71.95	71.96	70.72	-----

TABLE 8: **Mobile plant field testing results - Alchem flocculants**

Test	AA1				AA2	AA3		
Date	851007				851007	851008		
Time	0915				1620	1240		
Duration (min)	0 - 60	60 - 120	120-300	300-380	45 - 105	0 - 40	40 - 90	90 - 125
Floc dosages (g/t)								
Cationic	6.21	10.92	28.43	36.25	33.10	5.67	11.39	23.87
Anionic	49.76	87.53	227.84	290.50	265.30	45.48	91.32	191.28
Floc. Cost (/t)	15.42	27.13	70.62	90.04	82.23	14.10	28.31	59.29
Feed								
Solids Content (%)	4.67	5.31	4.08	4.00	4.38	5.11	5.09	4.86
Minus 44 μm (%)	85.54	88.10	87.72	87.68	89.83	83.68	-----	84.84
Mean Particle Size (μm)	16.6	16.7	16.6	17.4	15.5	18.0	-----	17.9
Ash Content (%)	68.84	68.42	68.14	69.24	70.99	71.55	71.89	71.79
Overflow								
Wedge Clarity								
Initial	0	9	11	16	10	0	0	17
Final	9	11	16	46	33	0	17	16
Average	7	11	19	33	23	0	7	17
Underflow								
Solids Content (%)								
Initial	15.65	11.69	16.74	19.80	12.57	10.16	9.79	14.28
Final	11.69	16.74	19.80	26.13	21.50	9.79	14.28	15.80
Average	11.50	13.69	18.80	23.88	19.30	10.37	12.93	15.23
Ash Content (%)	70.52	70.91	70.26	70.62	73.73	73.07	73.27	72.65

TABLE 8: **Mobile plant field testing results - Alchem flocculants (cont'd)**

Test	A13	A14	A14 (Rep)	A15	A15 (Rep)	A16	A17	A18	A19	A20
Date	850619		850624	850624		850625				
Time	1450	1610	1245	1340	1630	1020				1515
Duration (min)	0 - 50	0 - 50	0 - 50	0 - 60	0 - 65	0 - 55	55 - 105	105 - 170	170 - 230	0 - 60
Floc dosages (g/t)										
Cationic	10.28	9.57	9.92	11.18	6.45	8.75	7.89	7.64	8.86	7.60
Anionic	34.18	31.95	33.14	74.63	43.07	21.53	39.50	57.39	86.90	76.08
Floc. Cost (/t)	11.56	10.80	11.20	23.43	13.53	7.64	12.72	17.87	26.59	23.28
Feed										
Solids Content (%)	2.86	3.06	2.95	2.62	4.54	4.46	4.95	5.11	4.50	5.14
Minus 44µm(%)	86.80	86.56	87.47	85.79	84.49	85.78	84.22	82.99	85.21	87.03
Mean Particle Size (µm)	17.20	17.20	16.30	17.9	18.0	18.0	18.6	18.6	18.0	16.6
Ash Content (%)	71.38	69.95	68.48	69.94	67.29	69.45	68.99	69.57	70.49	69.66
Overflow										
Wedge Clarity										
Initial	0	7	0	5	0	0	3	2	3	3
Final	25	10	5	28	6	3	2	3	7	20
Average	11	8	4	13	6	3	2	3	5	15
Underflow										
Solids Content (%)										
Initial	9.00	7.42	5.77	5.99	12.29	6.15	7.13	7.82	7.92	22.51
Final	8.43	7.96	5.99	10.55	10.74	7.13	7.82	7.92	8.53	20.49
Average	7.95	7.68	5.94	7.69	10.70	6.80	7.63	7.89	8.55	21.77
Ash Content (%)	67.04	70.03	66.38	68.22	66.75	64.75	65.31	65.86	67.41	69.92

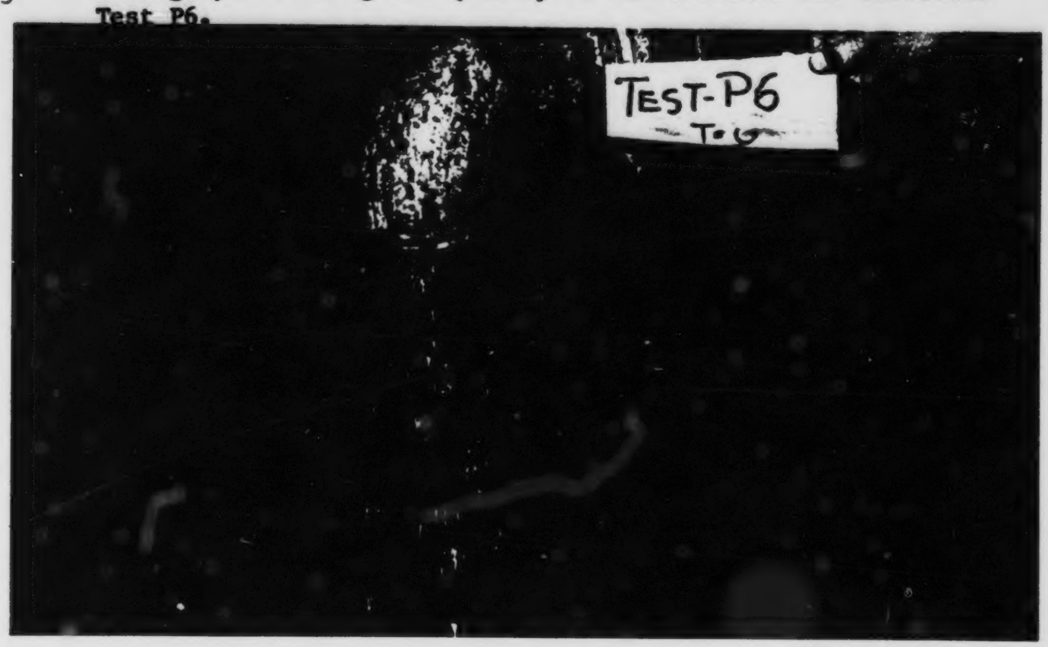
TABLE 9: Rating of flocculants based on CPI method - pilot scale [field testing]

Flocculants	Price* $/kg	Optimum Dosage kg/t	Optimum Dosage ¢ /t	Overflow Clarity (Wedge)	Underflow % Solids	CPI	Rating Order
1. Allied Colloids Cation + Anion	1.78 3.08	0.0312 0.2503	82.66	46	25.18	3.28	8
Anion + Cation		0.0286 0.2295	75.79	46	29.11	2.60	6
2. Hart + Alchem Cation + Anion	1.60 2.95	0.0107 0.0859	27.06	20	29.59	2.10	5
Anion + Cation		0.0223 0.1848	58.08	46	31.94	1.82	4
3. Diachem Cation + Anion	1.55 2.99	0.0122 0.1836	56.78	46	35.43	1.60	2
Anion + Cation		0.0736 0.1769	54.05	46	20.16	2.68	7
4. Calgon Cation + Anion	1.49 2.80	0.0068 0.0545	16.29	24	17.46	1.79	3
Anion + Cation		0.0156 0.1253	37.41	46	28.24	1.32	1
5. Alchem Cation + Anion	1.60 2.90	0.0326 0.2905	90.04	46	26.13	3.45	9
Anion + Cation		0.0331 0.2653	82.23	33	21.50	5.33	10

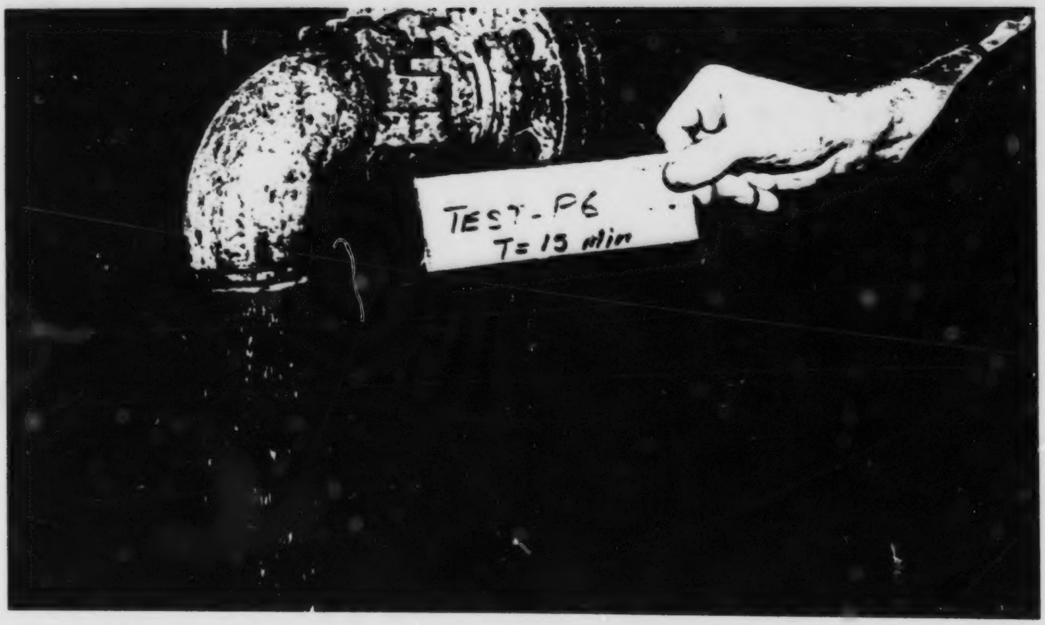
* The flocculant price is based on a 20,000 kg shipment.

$$\text{CPI} = \frac{\text{Optimum dosage (¢/t)}}{\text{O/F clarity}} \left| \frac{\text{Max. O/F clarity (46)}}{\text{U/F Concentration}} \right| \left| \frac{1}{\qquad} \right|$$

Fig. 3 - Photographs showing the quality of the overflow and underflow Test P6.

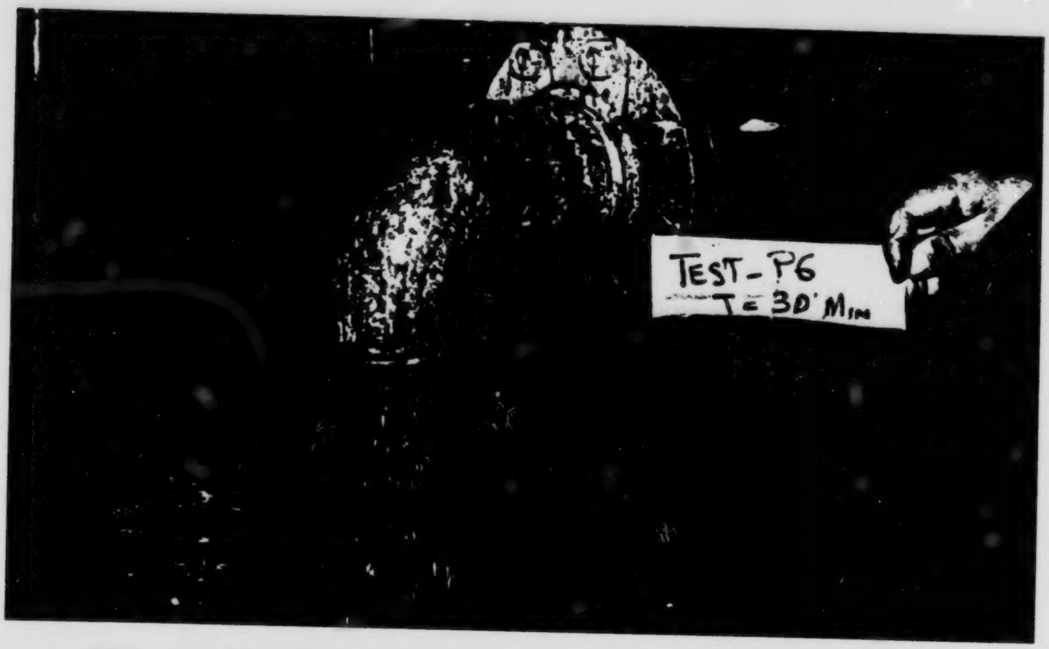


(a) Time = 0 min



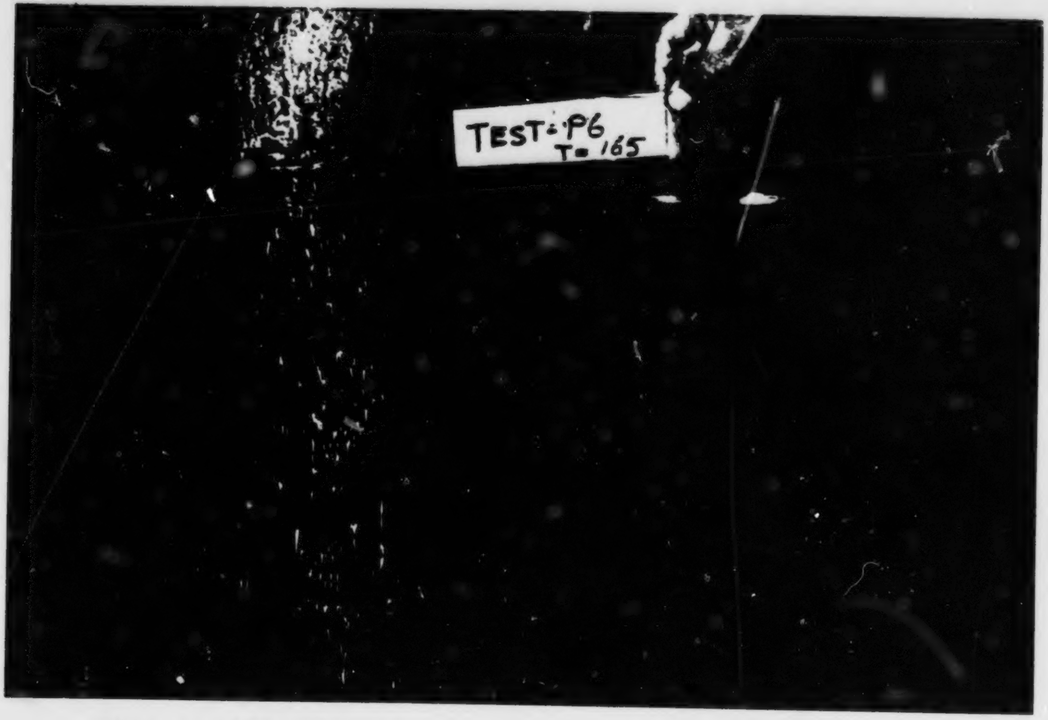
(b) Time = 15 min.

1732



(c) Time = 30 min

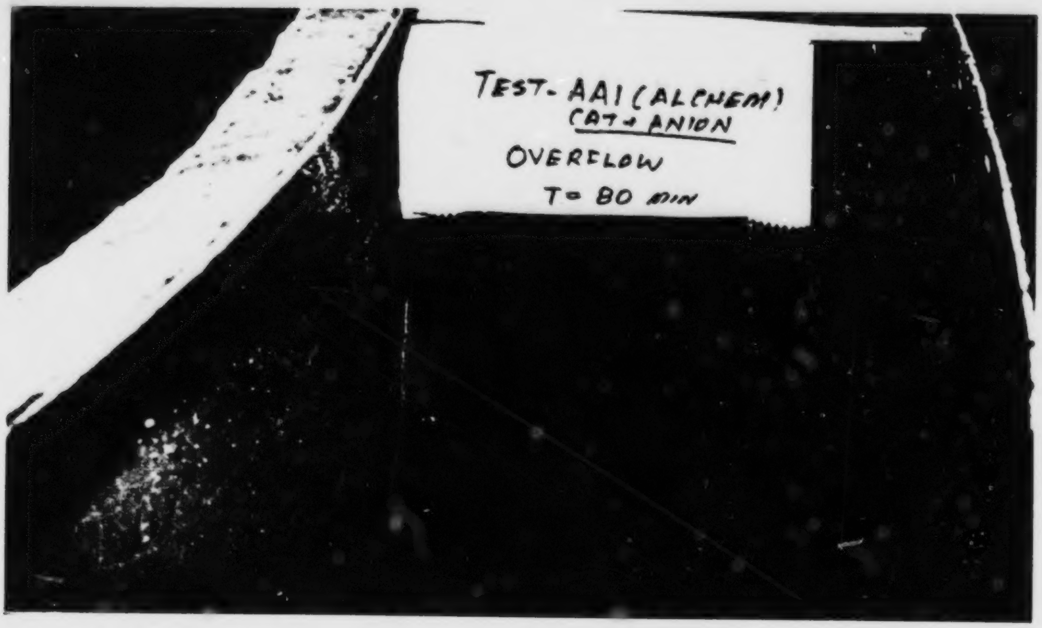
(d) Time = 90 min.



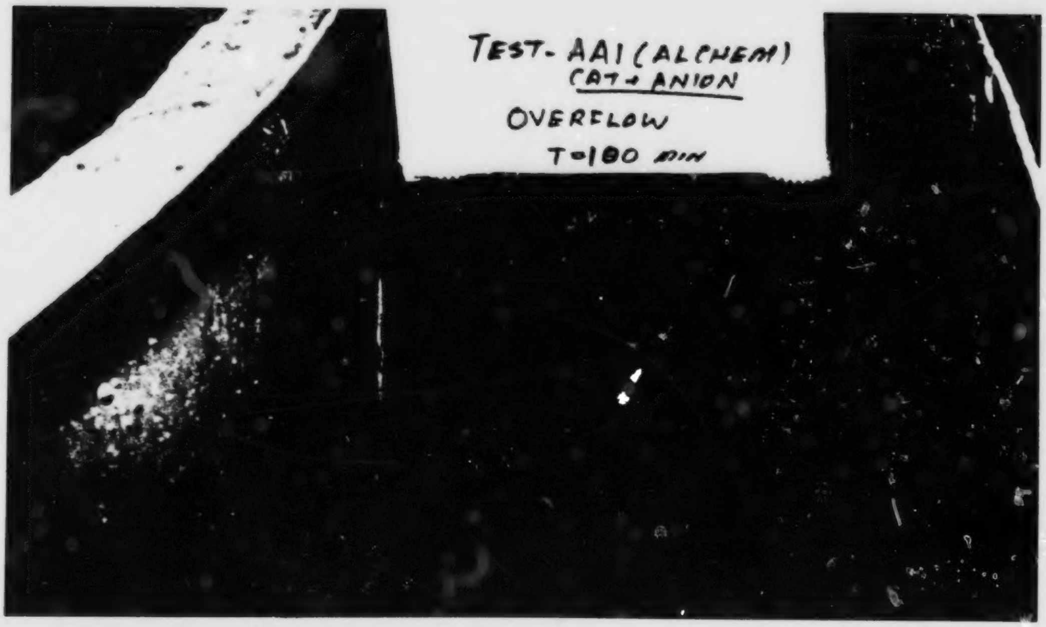
(e) Time = 165 min

1732

Fig. 4 Photographs showing the overflow quality as test AA1 progresses

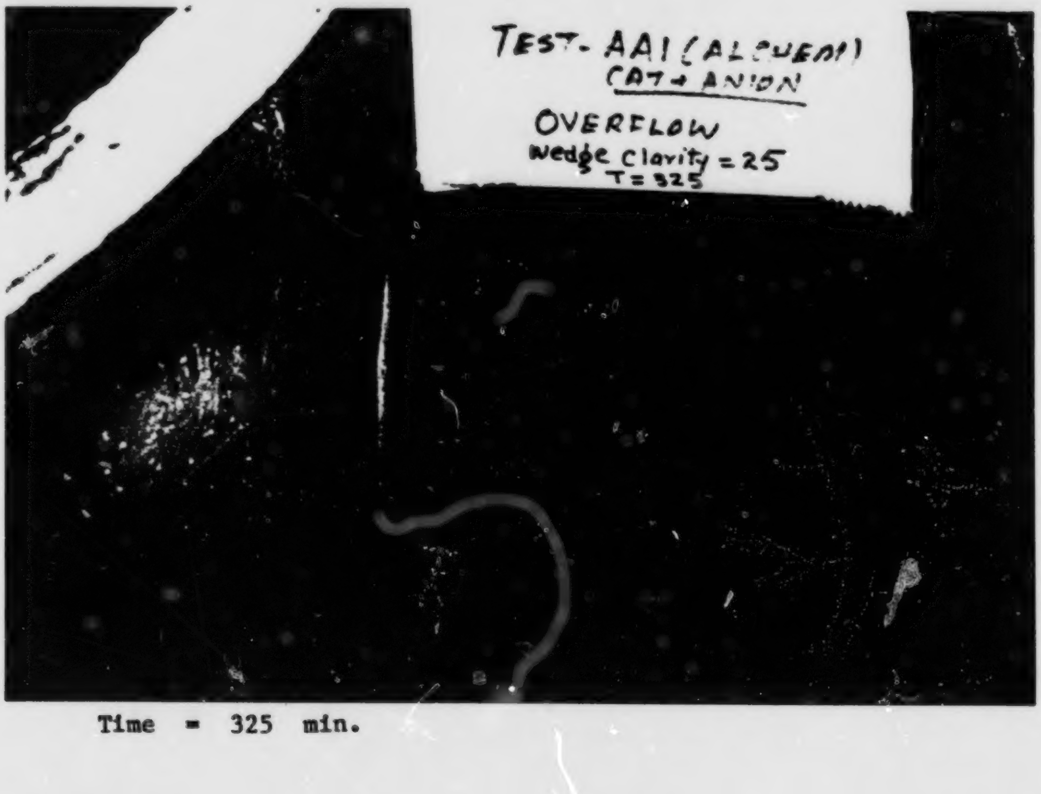


(a) Time = 80 min



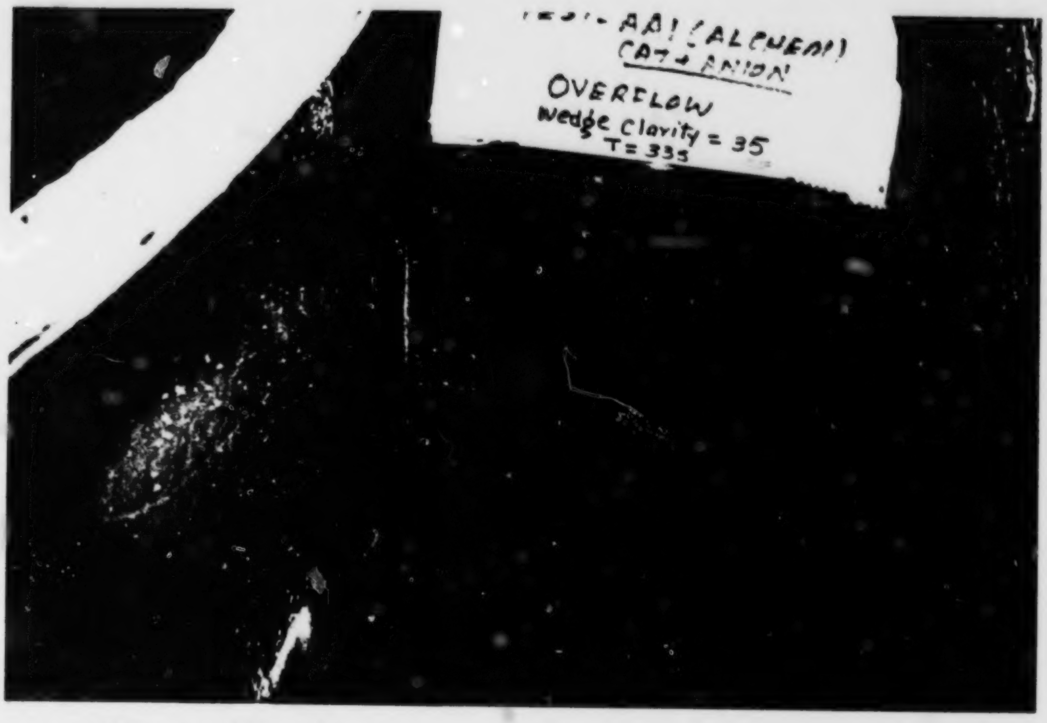
(b) Time = 100 min.

(c) Time = 120 min

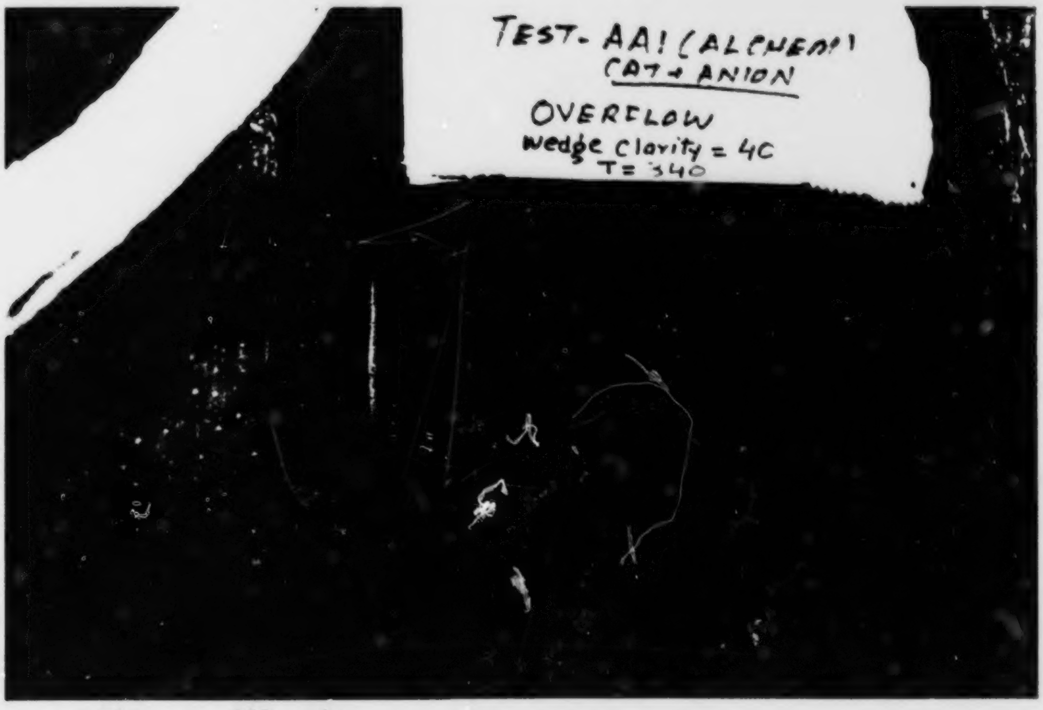


(d) Time = 325 min.

1732



(e) Time = 335 min



(f) Time = 340 min.

(g) Time = 345 min

Monitoring of the Washery Thickeners Performance

The experimental work plan also included monitoring performance of the washery thickeners. Feed, overflow and underflow samples were collected and analyzed for solids concentration, size consist (feed samples only) and ash content. The results are included in Appendix D. A total of 90 samples from the high ash thickener and 36 from the low ash thickener were collected. Table 10 contains the average values, and Figures 5 to 8 show variations in the monitoring data.

Table 10 - Monitoring results of the high and low ash thickeners (average values).

Thickener	% Solids			Ash Content			Size
	Feed	Overflow	Underflow	Feed	Overflow	Underflow	%-100 Mesh (Feed)
High Ash	4.21	Clear	19.95	67.42	NES	64.87	96.76
Low Ash	4.56	Clear	28.84	57.08	NES	53.21	93.23

NES - Not Enough Solids to determine ash content.

Monitoring of the Washery Flocculant Consumption

During the testing period the consumption of the washery flocculants (Alchem 8852 and 8C26) was monitored by recording the change in the tank level. Table 10 shows the flocculant consumption and flocculant cost (per tonne of clean coal). The amount of clean coal produced per day and the actual operating hours were obtained from the daily plant operating report sheet.

TABLE 11: Monitoring of the Washery Flocculant Consumption

Date and Time	Flocculant Consumption L/hr		Flocculant Consumption (g/t of clean coal)		Flocculant Cost (¢/t of clean coal)
	Anionic	Cationic	Anionic	Cationic	
June 10 - 1815	32.22	49.57	92.70	145.26	50.13
June 16 - 1900	37.51	99.28	89.62	241.58	64.64
June 17 - 1120	33.45	50.18	91.12	139.23	48.70
June 17 - 1900	30.76	56.78	75.64	142.20	44.69
June 18 - 0945	49.43	53.92	144.62	160.68	67.65
June 18 - 1815	24.08	66.88	55.84	157.97	41.47
June 19 - 0915	12.15	36.44	31.06	94.88	24.19
June 19 - 1650	40.70	65.11	100.55	163.84	55.37
June 24 - 1305	27.95	69.87	131.20	334.04	91.49
June 24 - 1810	48.83	56.15	140.50	164.55	67.07
June 25 - 0900	40.34	71.71	85.99	155.69	49.85
June 25 - 1705	58.90	79.94	120.45	166.52	61.58
June 26 - 0940	68.07	68.07	138.41	140.97	62.69
June 26 - 1750	65.67	61.92	167.00	160.38	74.09
June 27 - 1325	137.50	103.13	311.25	237.78	128.30
June 27 - 1510					
AVERAGE	47.17	65.93	112.32	173.70	63.13

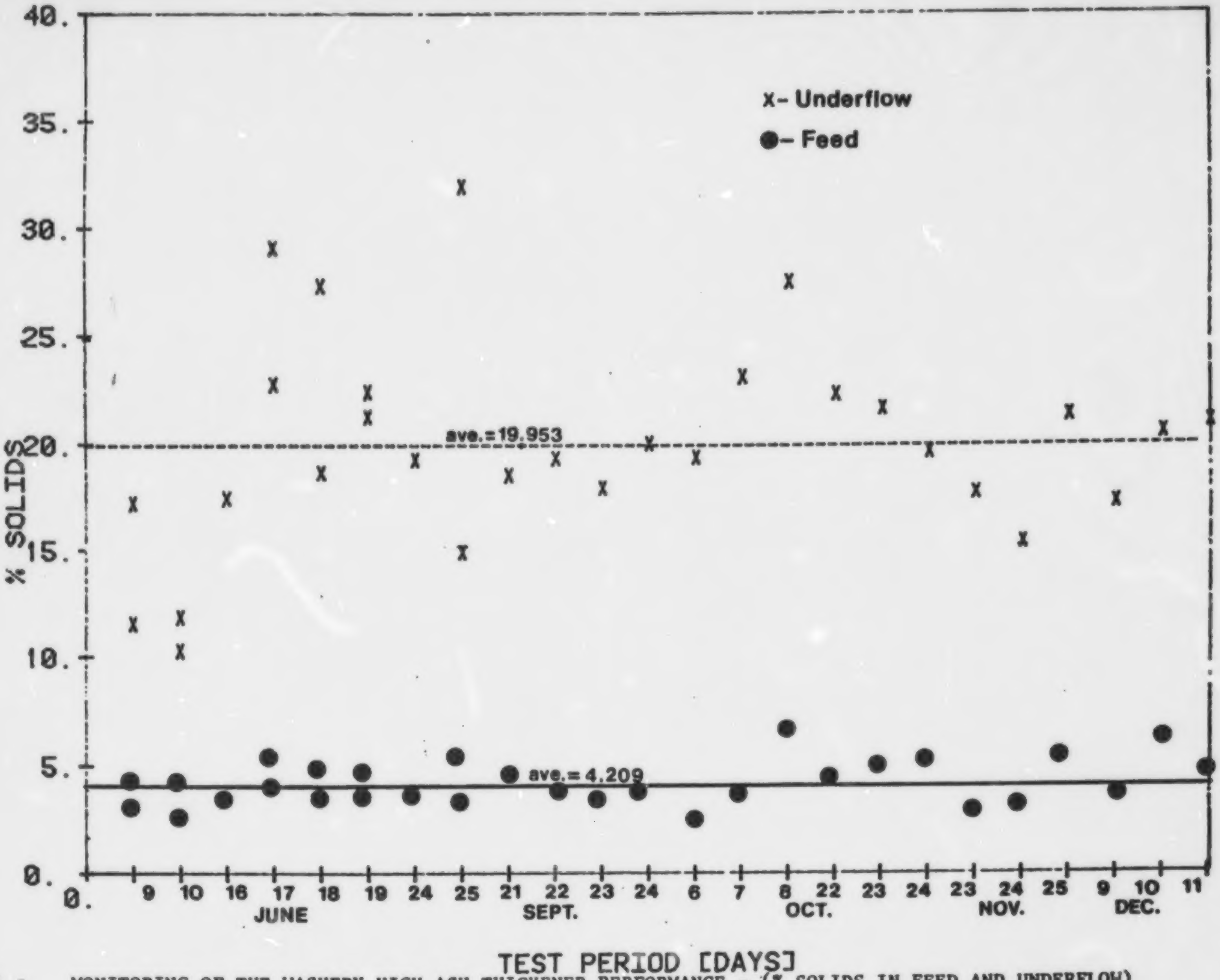
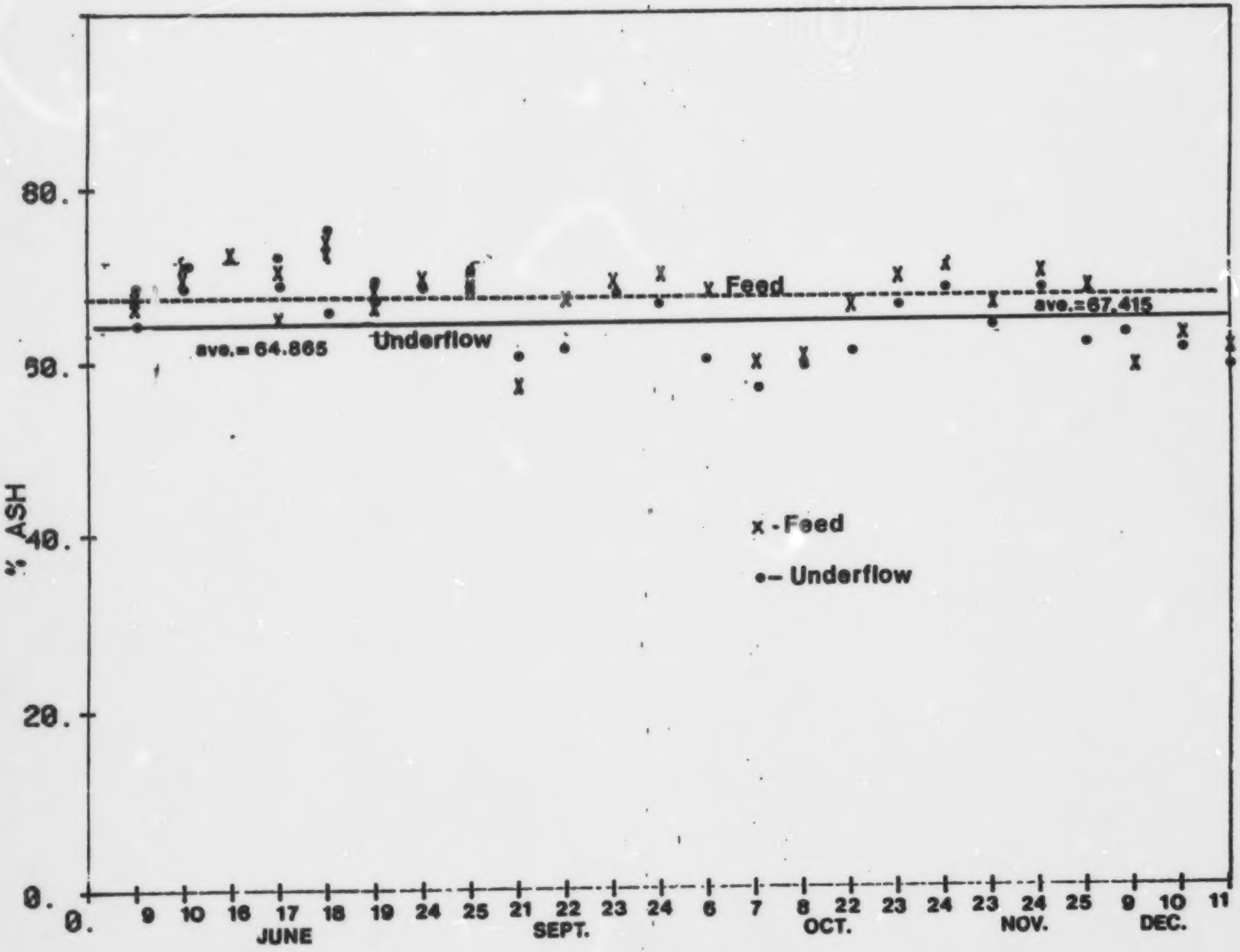


FIG. 5 MONITORING OF THE WASHERY HIGH ASH THICKENER PERFORMANCE - (% SOLIDS IN FEED AND UNDERFLOW)



TEST PERIOD [DAYS]

FIG. 6 MONITORING OF THE WASHERY HIGH ASH THICKENER PERFORMANCE – (ASH CONTENT IN FEED AND UNDERFLOW).

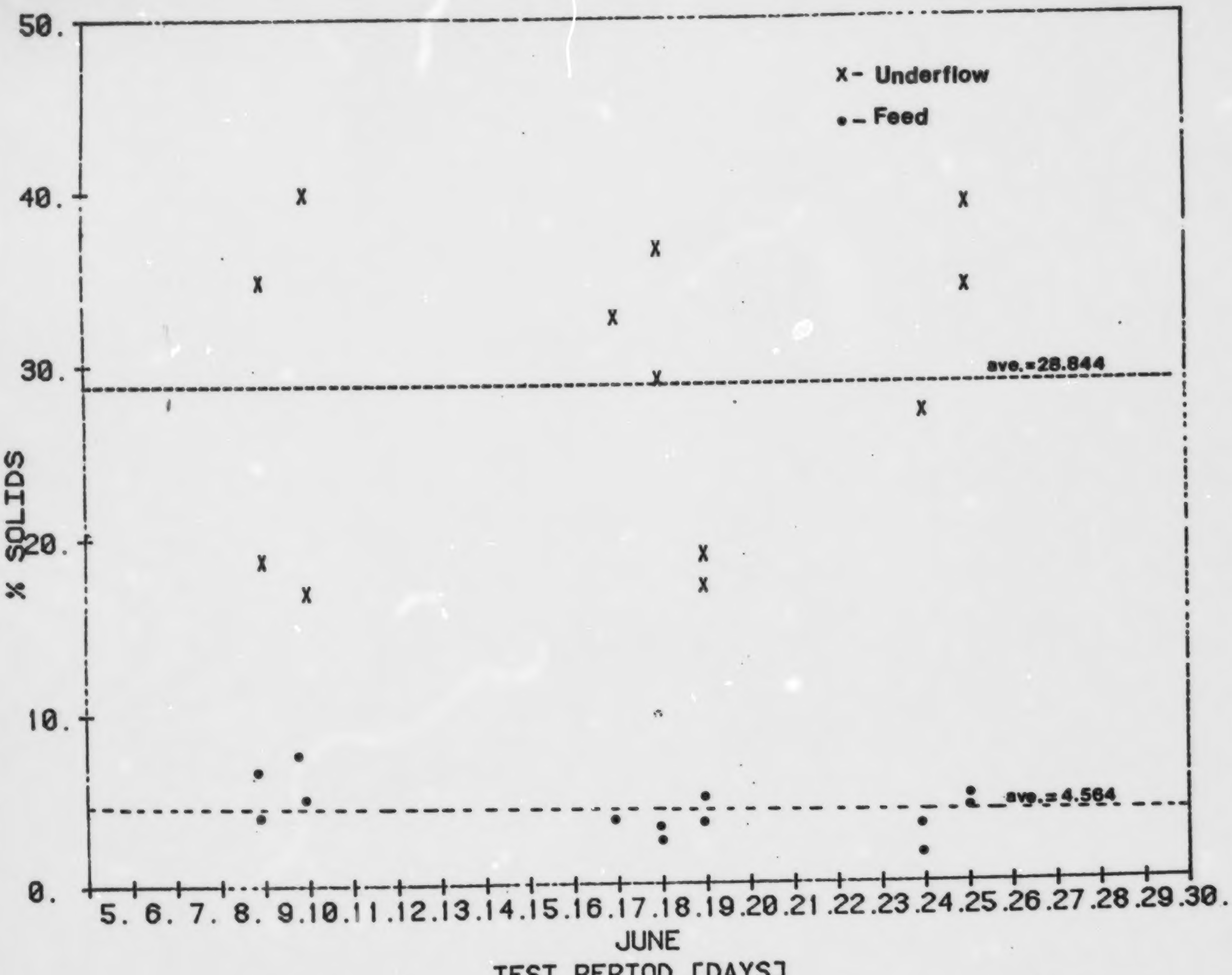


FIG. 7 MONITORING OF THE WASHERY LOW ASH THICKENERS PERFORMANCE (% SOLIDS IN FEED AND UNDERFLOW).

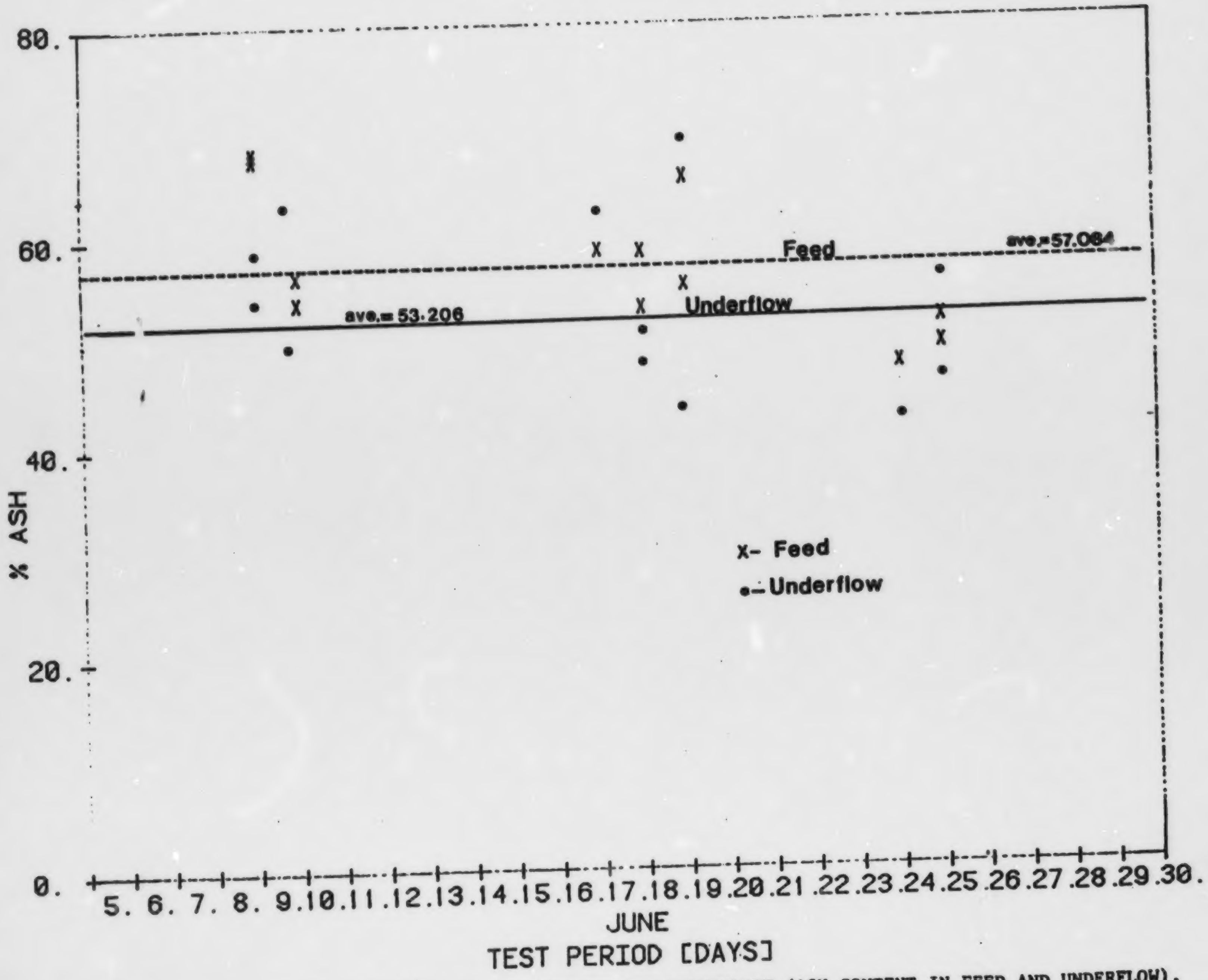


FIG. 8 MONITORING OF THE WASHERY LOW ASH THICKENER PERFORMANCE (ASH CONTENT IN FEED AND UNDERFLOW).

CONCLUSIONS

The major conclusions that may be drawn from this study are:

1. The bench scale and the pilot scale results have indicated that the order of flocculant addition is an important parameter. For example, Calgon flocculants gave better results when anionic (1691E) was added first followed by cationic (M502). Diachem flocculants, on the other hand gave much improved results when cationic (4421) was added first, followed by anionic (2890).

2. When the rating is based on strictly performance i.e. target values of overflow clarity of at least 30 and underflow solids concentration of 30-35%; Diachem (4421 and 2890) is best, followed by Hart CFA30 plus Alchem 8852.

3. When rating is based on performance and cost (CPI method) Calgon is ranked first, followed by Diachem.

4. The monitoring of washery flocculant (Alchem 8852 and 8C26) consumption has indicated that the flocculant usage is high, anionic 31-311 gram per tonne of clean coal and cationic 95-24 gram per tonne of clean coal. This amounts to 35 - 92 cents per tonne of clean coal.

APPENDIX "A"

[DETAILS OF TESTS]

DETAILS OF TEST-P [ALLIED COLLOIDS FLOCCULANTS]

Test I.D. and duration [min]	Order of floc. addition [Cat + An]/ [An + Cat]	Floc. dosages times the bench scale opt. dosages	Flocculant Dosages [g/t]			
			Cationic		Anionic	
			Aimed	Actual	Aimed	Actual
Test - P1:	Only					
0 - 45	anionic	0.50	---	---	116.20	87.37
45 - 90	floc. was	1.00	---	---	232.40	231.82
90 - 145	used	2.00	---	---	464.80	469.49
Test - P2:						
0 - 45	Cat + An	1.00	14.50	13.27	116.20	106.36
45 - 105		2.00	29.00	23.97	232.40	192.07
Test - P3:						
0 - 45	An + Cat	1.00	14.50	13.36	116.20	107.10
45 - 100		2.00	29.00	26.24	232.40	210.32
Test - P4*						
0 - 125	An + Cat	2.0	29.00	30.21	232.40	240.08
Test - P5**						
0 - 40	Cat + An	2.0	29.00	32.04	232.40	256.79
40 - 120		3.0	43.50	45.08	348.60	361.24
Test - P6:						
0 - 225	Cat + An	3.0	43.50	31.24	348.60	250.34
Test - P7:						
0 - 80	An + Cat	2.0	29.00	28.64	232.40	229.53

* Test P3 was discontinued due to interruption in feed supply; Test P4 is a continuation of Test P3.

** Continuation of Test P2.

DETAILS OF TEST-H [HART CROSSFLOC CFA-30 AND ALCHEM 8852 FLOCCULANTS]

Test I.D. and duration [min]	Order of floc. addition [Cat + An]/ [An + Cat]	Floc. dosages times the bench scale opt. dosages	Flocculant Dosages [g/t]			
			Cationic		Anionic	
			Aimed	Actual	Aimed	Actual
Test - H1:						
0 - 40	Cat + An	0.50	7.25	5.18	58.10	41.50
40 - 90		1.0 [AN]*	7.25	5.11	116.20	81.97
90 - 140		2.0 [AN]*	7.25	5.30	232.40	172.79
140 - 185		1.0 [CAT]**	14.50	11.44	232.40	188.35
185 - 220		2.0 [CAT]**	29.00	26.36	232.40	211.27
Test - H2:						
0 - 45	An + Cat	0.50	7.25	5.81	58.10	46.57
45 - 100		1.00	14.50	11.84	116.20	94.86
100 - 210		2.00	29.00	22.27	232.40	184.81
Test - H3:						
0 - 230	Cat + An	0.50	7.75	5.13	116.20	82.26
230 - 330		1.00	14.50	10.72	116.20	85.91
Test - H4:						
0 - 150	An + Cat	2.00	29.00	22.92	232.40	183.72
Test - H5:						
0 - 80	Cat + An	1.00	14.50	11.84	116.20	94.86
Test - H6:						
0 - 80	An + Cat	2.00	29.00	27.75	232.40	222.39

* Only the dosages of anionic flocculant were increased.

** Only the dosages of cationic flocculant were increased.

DETAILS OF TEST-D [DIACHEM FLOCCULANTS]

Test I.D. and duration [min]	Order of floc. addition [Cat + An]/ [An + Cat]	Floc. dosages times the bench scale opt. dosages	Flocculant Dosages [g/t]			
			Cationic		Anionic	
			Aimed	Actual	Aimed	Actual
Test - D1:	Only Anionic [2890] was used					
0 - 40		0.50	---	---	116.20	87.37
40 - 80		1.00	---	---	232.40	231.82
80 - 180		2.00	---	---	464.80	469.49
Test - D2:	Only Cationic [4421] was added					
0 - 35		0.50	116.20	206.58	---	---
35 - 105		1.00	232.40	380.98	---	---
Test - D3:						
0 - 40	Cat + An	0.50	2.90	3.60	43.60	54.16
40 - 80		1.00	5.80	7.12	87.20	106.99
80 - 125		1.50	8.70	12.20	130.80	183.58
Test - D4						
0 - 135	Cat + An	1.50	8.70	10.12	130.80	152.09
Test - D5						
0 - 45	An + Cat	0.50	7.25	6.90	58.10	55.33
45 - 90	Note: Only the dosage of anionic floc. was increased	0.75	7.25	6.16	87.15	74.01
90 - 150		1.00	7.25	5.98	116.20	95.83
150 - 210		1.25	7.25	5.44	174.30	109.01
Test - D6:						
0 - 150	An + Cat	1.25	7.25	7.36	174.30	176.95

DETAILS OF TEST-C [CALGON FLOCCULANTS]

Test I.D. and duration [min]	Order of floc. addition [Cat + An]/ [An + Cat]	Floc. dosages times the bench scale opt. dosages	Flocculant Dosages [g/t]			
			Cationic		Anionic	
			Aimed	Actual	Aimed	Actual
Test - C1: 0 - 95	Cat + An	0.50	7.25	6.81	58.10	54.55
Test - C2: 0 - 95	Cat + An	1.00	14.50	16.76	116.20	134.33
Test - C3: 0 - 80	Cat + An	2.00	28.10	40.14	232.40	332.00
Test - C4: 0 - 65	An + Cat	0.50	7.25	9.18	58.10	73.54
Test - C5: 0 - 135	An + Cat	1.00	14.50	15.63	116.20	125.28
Test - C6: 0 - 80	An + Cat	2.00	28.10	24.17	232.40	199.91

DETAILS OF TEST-A [ALCHEM FLOCCULANTS]

Test I.D. and duration [min]	Order of Floc. addition [Cat + An]/ [An + Cat]	Floc. dosages times the bench scale opt. dosages	Flocculant Dosages [g/t]			
			Cationic		Anionic	
			Aimed	Actual	Aimed	Actual
Test - AA1						
0 - 60		0.50	7.25	6.21	58.10	49.76
60 - 120	Cat + An	1.00	14.50	10.92	116.20	87.53
120 - 300		2.00	29.00	28.43	232.40	227.84
300 - 380		2.50	36.25	36.25	290.50	290.50
Test - AA2						
0 - 115	Cat + An	2.50	36.25	33.10	290.50	265.30
Test - AA3						
0 - 40	An + Cat	0.50	7.25	5.67	58.10	45.48
40 - 90		1.00	14.50	11.39	116.20	91.32
90 - 125		2.00	29.00	23.87	232.40	191.28
Test (A1 - A3)	Only Anionic flocculant was added.					
A1 - 0 - 70			----	----	20.40	28.04
A2 - 70 - 135			----	----	40.80	58.49
A3 - 135 - 195			----	----	81.60	130.56
Test - A-4	same as above					
0 - 60			----	----	61.60	100.16
Test (A5 - A8)						
A5 - 0 - 65			2.44	2.46	48.88	49.37
A6 - 65 - 125	An + Cat		4.88	5.54	48.88	55.54
A7 - 125 - 175			4.88	6.08	73.20	91.21
A8 - 175 - 225			9.76	11.48	73.20	86.12

DETAILS OF TEST-A [ALCHEM FLOCCULANTS] [PAGE 2 CONTINUED]

Test I.D. and duration [min]	Order of floc. addition [Cat + An]/ [An + Cat]	Floc. dosages times the bench scale opt. dosages	Flocculant Dosages [gm/t]			
			Cationic		Anionic	
			Aimed	Actual	Aimed	Actual
Test: (A9-A10)						
[A9] 0 - 40	Cat + An		4.88	5.44	24.44	27.23
[A10] 40 - 75			4.88	4.75	48.88	47.57
Test - A11						
0 - 75	Cat + An		4.88	6.32	48.88	63.27
Test - A12						
0 - 45	Cat + An		7.32	7.09	24.44	23.67
(Discontinued)						
Test A13:						
0 - 50	Cat + An		7.32	10.28	24.44	34.10
(Discontinued)						
Test A14:						
0 - 50	Cat + An		7.32	9.57	24.44	31.95
(Discontinued)						
Test A14(R) -A15:						
A14(R) 0 - 50	Cat + An		7.32	9.92	24.44	33.14
[A15] 50 - 125			7.32	11.18	48.88	74.63
Test 15(R):						
0 - 60	Cat + An		7.32	6.45	48.88	43.07
Test (A16-A19)						
[A16] 0 - 55			9.76	8.75	24.76	21.53
[A17] 55 - 105	Cat + An		9.76	7.89	48.88	39.50
[A18] 105 - 170			9.76	7.64	73.32	57.39
[A19] 170 - 230			9.76	8.68	97.76	86.90
Test A20:						
0 - 60			9.76	7.60	97.76	76.08

APPENDIX "B"

[LABORATORY ANALYSIS - % SOLIDS, ASH CONTENT AND SIZE ANALYSIS]

TEST DURATION (MIN)	TEST P1				TEST P2				TEST P3			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
0	3.99	76.06	9.81	71.98	4.01	71.79	20.36	62.50	3.92	74.42	10.70	75.31
15	4.27	77.18	9.36	76.44	4.43	73.53	8.99	61.12	4.26	73.60	11.89	75.25
30	3.99	77.13	10.08	76.84	4.52	75.17	8.73	64.73	4.55	74.55	11.08	74.53
45	3.71	77.40	10.68	76.09	4.53	75.93	7.20	69.64	4.65	74.47	9.57	75.35
60	4.16	75.85	11.25	76.29	4.84	74.85	7.53	70.40	4.44	74.25	11.23	75.10
75	4.07	77.25	10.75	76.73	5.20	75.25	9.32	73.62	4.22	74.38	10.72	75.22
90	4.11	77.10	10.44	76.35	4.78	75.38	9.38	73.69	4.37	74.41	11.37	75.32
105	3.95	76.05	11.05	76.55								
120	3.77	77.23	9.33	76.11								
135	4.02	76.85	10.51	76.42								
150												
165												

TEST DURATION (MIN)	TEST P4				TEST P5				TEST P6			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
0	4.05	73.45	11.15	72.35	3.91	70.90	11.97	74.24	5.47	75.78	5.64	74.47
15	3.83	73.23	16.23	71.05	3.20	74.80	13.77	76.00	5.90	74.45	12.94	72.90
30	3.67	73.51	14.55	72.51	4.26	75.15	18.81	76.43	6.19	74.19	7.44	71.61
45	4.00	74.02	12.33	72.27	3.11	74.56	19.82	74.69	6.22	74.80	0.03	72.64
60	3.85	73.77	13.75	71.58	4.10	73.75	26.72	76.05	6.93	74.13	9.43	74.23
75	3.76	73.47	15.40	71.43	4.05	74.20	27.05	74.73	6.77	74.85	14.58	74.85
90	4.11	74.11	19.22	72.05	3.92	74.11	30.70	76.75	4.65	75.20	12.66	71.96
105	4.65	74.25	20.75	72.33	3.85	73.14	30.15	75.20	4.81	76.04	16.31	74.89
120	4.23	74.15	21.02	71.40	4.15	74.09	29.63	76.32	5.46	73.78	22.56	73.95
135									5.76	75.47	24.18	75.63
150									3.88	75.88	24.35	75.85
165									5.32	77.68	23.13	75.95

TEST DURATION (MIN)	TEST P4				TEST P5				TEST P6			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
180									5.63	75.50	24.82	74.61
195									spilled		24.93	74.33
210									4.97	75.30	25.18	76.35
225												
240												
255												
270												
285												
300												
315												
330												
345												

TEST DURATION (MIN)	TEST P7				TEST P2				TEST P3			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
0	4.37	76.33	10.52	74.29								
15	4.12	75.15	12.35	75.60								
30	3.80	75.22	18.77	75.63								
45	4.29	76.20	28.12	74.22								
60	3.75	75.47	27.60	75.50								
75	3.95	75.82	29.11	75.62								
90												
105												
120												
135												
150												
165												

SIZE ANALYSIS OF FEED SAMPLES: TEST P(P1 - P5)

SAMPLE I.D.	SCREEN SIZE [MICRON]						
	+ 600	250	150	106	75	45	-45
Test P1 [T=20]	0	0.37	2.11	2.70	3.95	5.63	85.24
P1 [T=95]	0	0.75	2.36	3.20	4.62	4.75	84.32
P1 [T=130]	0	0.53	1.95	3.02	3.84	4.70	85.96
P2 [T=25]	0	0.11	1.10	2.29	4.55	6.20	85.75
P2 [T=80]	0	0	1.52	2.39	4.35	5.70	86.04
P3 [T=20]	0	0	0.98	2.12	3.95	6.15	86.80
P3 [T=80]	0	0.10	1.12	3.05	3.55	5.64	86.54
P4 [T=30]	0	0.21	1.27	2.24	4.52	6.10	85.66
P4 [T=90]	0	0.15	0.95	2.73	5.11	5.72	85.34
P5 [T=40]	0	0	0.30	1.22	2.73	6.14	89.60

TEST DURATION (MIN)	TEST H1				TEST H2				TEST H3			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
0	5.80	79.42	14.28	76.02	5.12	69.55	9.49	70.45	5.66	71.22	15.12	71.44
15	5.55	77.93	10.50	75.97	5.03	69.59	7.80	70.25	5.54	72.01	14.78	72.02
30	5.68	76.90	13.69	76.40	5.09	69.38	8.03	69.29	4.98	72.32	13.55	71.87
45	5.36	77.21	17.64	76.62	4.73	68.89	11.99	70.70	5.30	71.92	13.66	71.55
60	5.25	78.17	18.18	78.04	4.66	*	13.04	70.42	5.44	71.77	16.88	71.82
75	6.18	78.65	24.06	78.33	4.89	72.33	19.06	70.38	3.81	71.63	15.62	72.40
90	5.89	78.09	32.38	77.14	5.11	71.75	22.26	70.35	5.98	71.92	18.76	73.62
105	5.41	77.26	28.06	77.98	5.11	71.84	18.89	71.11	5.94	72.45	16.46	73.11
120	5.13	74.88	28.25	79.31	4.99	71.33	19.15	72.50	6.43	72.67	22.35	72.85
135	5.27	76.12	31.48	77.64	5.08	71.59	18.85	72.52	6.57	72.45	18.71	71.89
150	5.18	75.95	31.05	77.03	4.99	*	18.95	*	6.32	72.67	23.34	72.83
165	5.27	74.06	37.55	78.04	4.94	70.98	33.40	72.00	6.20	72.95	20.85	73.56

* Sample missing or spilled

TEST DURATION (MIN)	TEST H1				TEST H2				TEST H3			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
180	4.58	73.70	31.03	77.40	4.92	71.35	32.35	73.29	6.12	72.69	24.13	72.96
195	4.60	75.06	34.25	77.04	4.92	71.09	35.01	73.33	5.58	72.33	24.57	73.72
210	4.01	74.97	32.20	76.82	5.28	71.20	31.94	72.95	5.11	71.60	26.63	74.64
225									5.77	71.32	27.89	73.96
240									5.27	71.47	30.63	74.52
255									5.77	72.21	30.25	74.77
270									5.02	72.40	29.32	74.92
285									4.91	71.67	30.66	74.85
300									5.53	71.32	28.65	74.78
315									5.63	72.15	29.76	74.96
330												
345												

TEST DURATION (MIN)	TEST H4				TEST H5				TEST H6			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
0	5.11	67.29	15.51	70.11	4.75	72.29	9.63	70.49	3.49	67.40	5.33	70.22
15	5.53	67.37	14.35	69.23	4.53	72.33	9.98	70.33	4.15	69.39	10.45	69.55
30	4.78	69.25	14.50	69.55	5.05	71.45	11.35	71.45	4.25	69.22	9.39	69.30
45	4.95	69.39	13.75	69.22	4.97	71.39	16.80	70.25	3.92	71.43	9.42	69.75
60	4.54	68.11	18.20	70.41	5.23	72.11	20.42	71.70	4.75	70.65	10.45	70.20
75	5.25	68.95	20.77	70.35	4.88	71.72	20.95	71.39	4.55	71.22	11.30	70.15
90	5.02	70.22	18.03	69.30								
105	5.11	70.10	19.25	69.85								
120	5.23	69.83	22.75	69.75								
135	5.20	69.80	22.03	70.11								
150	4.95	69.73	26.78	70.25								
165												

SIZE ANALYSIS OF FEED SAMPLES: TEST H(H1 - H6)

SAMPLE I.D.	SCREEN SIZE [MICRON]						
	+ 600	250	150	106	75	45	-45
Test H1 [T=45]	0	0.49	1.54	2.40	3.98	8.61	82.98
H1 [T=105]	0	0.35	1.76	3.12	5.12	7.27	82.38
H1 [T=180]	0	0.50	1.37	2.66	4.19	8.25	83.03
H2 [T=10]	0	0.19	1.12	3.18	4.15	6.87	84.49
H2 [T=60]	0	0.21	0.94	2.10	3.49	7.41	85.85
H2 [T=140]	0	0.39	1.36	3.11	4.10	8.02	83.02
H3 [T=45]	0.16	0.48	1.66	2.69	3.94	6.92	84.15
H3 [T=135]	0	0.72	2.10	3.35	4.19	7.12	82.52
H3 [T=210]	0.11	0.50	1.82	1.94	3.54	6.29	85.80
H3 [T=305]	0.27	0.35	2.11	3.20	4.13	7.26	82.68
H4 [T=30]	0	0.10	1.93	2.02	4.73	9.04	82.18
H4 [T=90]	0	0.47	1.36	1.91	3.91	8.65	83.70
H5 [T=20]	0	1.02	2.15	3.02	4.17	4.33	85.31
H5 [T=70]	0.12	0.65	1.96	3.63	3.26	5.01	85.37
H6 [T=10]	-	-	-	-	-	-	-
H6 [T=40]	0.17	0.77	2.35	2.97	2.97	4.75	86.02

TEST DURATION (MIN)	TEST D1				TEST D2				TEST D3			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
0	1.75	75.20	11.52	70.45	1.48	73.22	21.12	70.46	3.01	67.45	14.54	70.11
15	1.70	75.42	6.94	71.20	2.48	72.93	17.05	70.93	3.41	69.25	16.47	70.25
30	1.96	74.35	8.13	73.11	2.56	72.88	6.75	71.05	3.13	69.63	19.56	69.33
45	3.02	72.50	7.21	72.45	2.48	73.03	13.86	70.72	3.34	69.40	22.14	69.25
60	2.48	72.47	8.49	72.33	2.66	73.11	10.20	71.47	3.25	68.29	21.89	68.92
75	2.89	73.02	9.32	71.50	2.38	73.42	17.97	70.67	3.59	68.73	17.59	69.40
90	2.48	72.70	9.81	71.45	2.24	72.22	16.62	70.82	2.86	67.95	28.91	69.11
105	2.58	72.65	11.93	71.37	----	----	----	----	2.41	67.80	29.68	69.29
120	2.16	70.45	15.91	72.82	----	----	----	----	2.55	68.02	35.43	69.83
135	2.50	71.22	19.88	72.81	----	----	----	----	----	----	----	----
150	3.38	70.58	23.54	71.09	----	----	----	----	----	----	----	----
165	2.44	71.22	13.64	71.20	----	----	----	----	----	----	----	----
180	2.72	71.28	9.96	72.03	----	----	----	----	----	----	----	----

TEST DURATION (MIN)	TEST D4				TEST D5				TEST D6			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
0	3.11	68.40	12.02	66.33	4.17	70.42	22.89	70.10	4.43	66.45	12.63	72.19
15	3.27	68.19	15.81	65.92	4.16	71.02	9.23	69.30	6.09	67.10	11.39	71.35
30	2.99	68.33	20.72	67.11	3.94	71.19	9.13	69.49	4.51	67.29	7.45	72.10
45	3.39	67.95	23.43	66.59	4.53	70.48	10.34	68.11	3.27	67.45	9.57	72.29
60	4.06	67.90	23.62	68.29	4.82	70.75	8.51	68.20	3.45	67.29	7.97	31.40
75	3.38	68.11	23.69	67.47	4.71	71.45	9.49	69.19	3.47	67.45	8.46	71.55
90	3.23	68.53	24.15	68.39	4.79	69.45	8.77	70.12	3.57	87.10	9.45	71.30
105	3.69	67.92	24.24	68.31	5.30	69.73	8.55	70.25	3.62	69.25	*	71.67
120	3.80	67.59	26.70	68.40	4.32	70.55	8.43	70.08	2.72	69.70	13.95	70.42
135	3.45	67.42	26.89	67.22	4.98	70.45	8.49	69.28	4.09	70.20	18.83	70.30
150	—	—	—	—	(spilled)		9.83	68.45	4.14	69.73	20.16	71.10
165	—	—	—	—	4.78	70.22	9.54	68.29	—	—	—	—
180	—	—	—	—	5.28	70.85	12.36	69.10	—	—	—	—
195	—	—	—	—	5.46	71.10	14.48	69.63	—	—	—	—
210	—	—	—	—	5.81	70.27	14.04	70.05	—	—	—	—

SIZE ANALYSIS OF FEED SAMPLES: TEST D(D1 - D6)

SAMPLE I.D.	SCREEN SIZE [MICRON]						
	+ 600	250	150	106	75	45	-45
Test D1 [T=25]	0	0	0.95	2.03	3.15	4.29	89.58
D1 [T=70]	0	0.11	0.75	1.85	3.01	3.69	90.59
D1 [T=150]	0	0.27	0.78	1.97	2.77	3.97	90.24
D2 [T=30]	0	0.35	1.02	2.45	3.82	5.42	86.94
D2 [T=95]	0	0.15	0.80	1.98	4.10	4.32	88.65
D3 [T=20]	0	0.45	1.37	4.25	3.95	5.60	84.45
D3 [T=90]	0	0.37	2.02	4.65	4.85	6.62	81.49
D4 [T=35]	0	0.10	1.45	3.31	3.45	4.92	86.77
D4 [T=100]	0.12	0.75	1.35	2.90	3.70	6.33	84.85
D5 [T=35]	0	0	0.85	3.15	3.32	5.62	87.06
D5 [T=90]	0	0.18	1.02	2.72	3.80	6.42	85.86
D5 [T=170]	0	0	2.19	3.35	4.72	4.86	84.88
D6 [T=25]	0	0	1.45	2.83	4.30	5.11	86.31
D6 [T=105]	0	0.27	2.01	3.43	4.76	5.21	84.32

TEST DURATION (MIN)	TEST C1				TEST C2				TEST C3			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
0	3.15	69.53	12.47	70.03	2.94	73.99	14.22	72.12	2.88	67.81	15.63	72.31
15	4.44	71.67	18.01	70.52	3.51	75.56	17.54	75.04	3.01	72.09	27.06	71.74
30	4.62	69.76	18.40	*	3.24	75.10	22.81	72.80	2.97	74.28	29.90	71.25
45	4.19	70.57	15.55	71.76	3.76	73.93	23.33	75.30	2.93	72.20	28.10	72.59
60	4.22	70.55	18.70	*	3.55	74.05	22.75	73.55	2.25	68.74	26.90	72.54
75	4.55	69.30	19.75	70.08	3.75	74.05	22.30	72.25	2.75	69.72	27.83	71.30
90	4.63	70.05	19.35	71.46	----	-----	-----	-----	-----	-----	-----	-----

* Sample missing or spilled

TEST DURATION (MIN)	TEST C4				TEST C5				TEST C6			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
0	3.20	71.26	30.24	72.33	2.68	73.68	18.18	72.38	4.29	*	13.12	*
15	2.94	70.72	28.84	72.10	2.78	71.36	24.50	73.55	4.09	*	8.99	*
30	3.84	71.33	29.50	71.55	4.08	73.48	33.81	74.48	4.75	*	18.41	*
45	2.88	69.85	28.75	72.39	4.62	72.52	31.30	72.40	4.59	*	21.36	*
60	2.95	70.63	29.12	71.45	4.38	71.92	28.38	65.53	5.30	*	21.83	*
75	----	-----	-----	-----	4.28	72.10	26.93	66.34	4.28	*	16.93	*
90	----	-----	-----	-----	3.25	72.78	27.49	69.72	-----	-----	-----	-----
105	----	-----	-----	-----	3.04	68.63	35.94	71.90	-----	-----	-----	-----
120	----	-----	-----	-----	3.95	71.85	28.70	70.55	-----	-----	-----	-----
135	----	-----	-----	-----	4.05	72.02	27.15	70.38	-----	-----	-----	-----

* Samples missing

SIZE ANALYSIS OF FEED SAMPLES: TEST C(C1 - C6)

SAMPLE I.D.	SCREEN SIZE [MICRON]						
	+ 600	250 600x250	150 250x150	106 150x106	75 106x75	45 75 x 45	-45
Test C1 [T=30]	0.11	0.86	2.30	1.39	4.66	7.45	83.23
C1 [T=80]	0	0.98	3.01	2.32	5.10	8.12	80.47
C2 [T=35]	0	0.82	2.47	2.52	6.12	6.83	81.24
C2 [T=85]	0	0.55	2.15	3.06	7.12	6.50	80.62
C3 [T=30]	0	0.37	2.26	3.20	6.24	6.19	81.74
C3 [T=70]	0	0.68	1.83	2.86	3.95	7.64	83.04
C4 [T=40]	0	0.45	1.30	3.17	6.42	5.97	82.69
C5 [T=30]	0	0.72	1.22	3.05	6.13	6.39	82.49
C5 [T=115]	0	0.68	0.98	4.10	5.23	7.05	81.96
C6 [T=10]	0	0.19	1.22	2.10	3.76	6.40	86.33
C6 [T=60]	0	0.21	0.87	1.64	3.13	5.47	88.67

TEST DURATION (MIN)	TEST A1-A3				TEST A4				TEST A5-A8			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
0	2.37	67.12	6.79	66.50	2.42	70.51	4.25	68.18	3.91	57.46	17.32	53.18
15	2.72	66.55	4.31	66.43	2.40	70.52	3.75	68.81	3.97	60.24	23.69	48.86
30	3.02	66.23	5.25	65.33	2.43	70.24	4.04	68.00	4.29	62.68	19.86	56.24
45	3.00	67.01	4.71	65.75	2.52	70.73	3.85	69.32	4.15	67.64	21.70	57.66
60	3.29	67.22	4.76	66.55	2.55	70.34	4.40	*	3.49	71.94	23.18	59.40
75	3.07	67.10	5.02	66.85	----	-----	-----	-----	3.14	71.66	20.94	71.32
90	2.85	67.50	4.96	67.03	----	-----	-----	-----	3.28	72.40	17.61	69.26
105	2.70	68.19	4.80	67.49	----	-----	-----	-----	4.04	69.44	19.35	69.58
120	2.09	68.20	5.41	66.49	----	-----	-----	-----	3.65	71.35	18.70	67.40
135	2.05	67.10	5.56	68.11	----	-----	-----	-----	2.94	70.66	14.18	71.29
150	2.57	67.05	6.66	67.92	----	-----	-----	-----	2.90	70.05	15.07	69.80
165	2.00	66.25	7.10	68.12	----	-----	-----	-----	3.05	70.25	16.47	70.10

* Sample missing or spilled

TEST DURATION (MIN)	TEST A1-A3				TEST A4				TEST A5-A8			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
180	2.38	67.05	6.32	69.10	-----	-----	-----	-----	3.53	71.16	14.91	69.14
195	2.32	67.23	6.22	68.73	-----	-----	-----	-----	3.32	72.73	14.19	70.28
210	----	-----	----	-----	-----	-----	-----	-----	3.34	72.25	14.64	68.63
225	----	-----	----	-----	-----	-----	-----	-----	3.42	68.54	15.05	68.49

TEST DURATION (MIN)	TEST A9-A10				TEST A11				TEST A12			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
0	3.34	59.12	18.78	60.98	3.37	66.77	4.93	64.17	4.17	57.64	4.25	70.52
15	3.04	57.99	18.62	57.11	2.33	66.22	6.44	61.63	4.11	*	6.92	65.52
30	3.69	54.46	19.26	61.54	3.04	66.03	5.98	62.61	4.02	68.86	7.01	63.96
45	4.33	64.47	18.86	66.28	3.50	69.32	7.13	65.42	4.22	68.31	6.97	63.54
60	4.13	61.04	22.31	50.19	3.19	55.82	14.90	49.83	----	-----	-----	-----
75	3.88	64.46	18.25	57.99	3.12	54.59	28.69	37.84	----	-----	-----	-----

TEST DURATION (MIN)	TEST A13				TEST A14				TEST A14 (Repeat) -A15			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
0	1.87	71.08	9.00	64.40	3.371	71.47	7.42	69.02	2.93	68.27	5.77	66.66
15	2.91	71.37	7.16	66.76	2.96	68.72	7.79	70.20	2.53	68.34	6.09	65.78
30	3.43	71.86	7.22	67.18	2.85	68.64	7.55	70.51	3.07	68.82	5.89	66.34
45	3.25	71.20	8.43	69.81	3.07	70.96	7.96	70.40	3.26	68.48	5.99	66.73
60	----	----	----	----	----	----	----	----	2.48	69.68	6.39	67.37
75	----	----	----	----	----	----	----	----	2.68	70.17	7.33	68.27
90	----	----	----	----	----	----	----	----	2.61	70.72	8.20	69.10
105	----	----	----	----	----	----	----	----	2.06	70.64	10.55	69.65

TEST DURATION (MIN)	TEST A15 (Repeat)				TEST A16-A19				TEST A20			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
0	4.84	70.10	12.29	66.24	4.269	69.58	6.146	65.67	5.073	69.96	22.51	70.05
15	4.91	65.81	9.53	67.69	4.218	68.72	6.610	64.24	5.183	69.63	20.86	69.88
30	4.48	66.82	10.20	67.56	4.479	69.84	7.042	65.27	5.200	69.78	22.38	69.64
45	4.83	66.58	10.74	67.09	4.402	69.66	7.082	63.80	5.120	69.50	22.59	69.92
60	3.63	67.16	10.74	65.16	4.950	70.11	7.125	64.54	5.107	69.43	20.49	70.09
75	----	----	----	----	5.015	71.51	7.633	65.12	----	----	----	----
90	----	----	----	----	4.755	68.35	7.940	66.27	----	----	----	----
105	----	----	----	----	5.077	68.99	7.815	65.31	----	----	----	----
120	----	----	----	----	5.254	70.24	7.792	65.45	----	----	----	----
135	----	----	----	----	5.192	70.08	7.966	66.06	----	----	----	----
150	----	----	----	----	5.013	68.84	7.942	66.58	----	----	----	----
165	----	----	----	----	5.021	69.70	7.915	65.91	----	----	----	----

TEST DURATION (MIN)	TEST A15				TEST A16-A19				TEST A20			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
180					4.709	70.06	8.724	66.11				
195					4.390	70.38	8.985	67.32				
210					4.278	71.36	9.050	68.76				
225					4.112	70.94	8.533	68.94				

TEST DURATION (MIN)	TEST AA1				TEST AA2				TEST AA3			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
0	5.01	68.40	15.65	70.16	4.70	70.39	12.57	74.22	5.54	71.29	10.16	73.40
15	3.74	69.23	9.30	70.29	4.25	70.57	11.21	73.50	4.93	72.11	11.26	73.55
30	4.55	67.83	10.09	71.41	5.05	70.14	19.73	74.19	4.94	71.72	10.26	72.83
45	4.88	69.42	10.77	70.27	4.32	71.82	22.89	73.22	5.01	71.08	9.79	72.49
60	5.19	69.33	11.69	70.45	3.57	71.70	22.10	74.15	5.02	72.63	14.29	73.70
75	5.55	68.49	12.37	70.32	4.16	71.52	22.05	73.22	5.54	71.45	13.34	73.49
90	5.29	67.80	13.59	71.04	4.24	70.45	22.37	74.11	4.80	72.39	14.28	73.39
105	5.62	68.11	14.05	71.32	4.73	71.33	21.50	73.22	4.77	71.12	15.62	72.11
120	4.88	68.38	16.74	71.40	----	-----	-----	-----	5.01	71.87	15.80	72.45
135	4.13	67.95	16.57	70.62	----	-----	-----	-----	----	-----	_____	_____
150	4.22	67.90	17.21	70.39	----	-----	-----	-----	----	-----	_____	_____
165	3.80	68.12	18.24	70.22	----	-----	-----	-----	----	-----	_____	_____

TEST DURATION (MIN)	TEST AA1				TEST AA2				TEST AA3			
	Feed		Underflow		Feed		Underflow		Feed		Underflow	
	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash	Solids	Ash
180	*	*	16.28	71.49								
195	3.94	66.42	18.55	71.38								
210	4.99	67.19	20.11	70.92								
225	4.39	67.20	22.79	70.65								
240	3.81	68.35	16.24	69.22								
255	3.18	68.42	23.41	68.18								
270	3.88	69.11	22.19	68.32								
285	3.86	69.36	16.23	70.42								
300	3.92	69.22	19.80	70.11								
315	3.89	68.61	25.30	70.95								
330	4.21	69.72	24.29	71.01								
345	3.97	69.42	26.13	70.42								

* Sample missing or spilled during transportation

SIZE ANALYSIS OF FEED SAMPLES: TEST A [TEST A1 - A11]

SAMPLE I.D.	SCREEN SIZE [MICRON]						
	+ 600	250 600x250	150 250x150	106 150x106	75 106x75	45 75 x 45	-45
Test A1 [T=30]	0	0.29	1.35	2.08	4.78	6.25	85.25
A2 [T=100]	0	0.17	1.77	3.02	4.10	5.95	84.99
A3 [T=165]	0	0.30	1.64	2.76	5.01	5.24	85.05
A4 [T=30]	0	0	1.12	2.92	4.84	6.10	85.02
A5 [T=30]	0	0.12	1.87	3.17	5.20	5.63	84.01
A7 [T=150]	0	0.12	1.12	2.15	2.12	3.95	90.54
A8 [T=200]	0	0.29	1.32	3.19	2.20	4.35	88.65
A9 [T=200]	0	0	1.42	3.62	3.29	5.65	86.02
A10 [T=60]	0	0.13	1.65	2.92	3.75	4.95	86.60
A11 [T=20]	0	0.22	1.21	2.70	4.53	6.73	84.61
A11 [T=60]	0	0.13	1.57	3.05	5.11	5.36	84.78

SIZE ANALYSIS OF FEED SAMPLES: TEST A [TEST A12-A20]

SAMPLE I.D.	SCREEN SIZE [MICRON]						
	+ 600	250	150	106	75	45	-45
Test A12 [T=30]	0	0.37	0.95	1.72	3.42	6.03	87.51
A13 [T=20]	0	0	1.10	2.37	3.58	6.15	86.80
A14 [T=30]	0	0.11	0.95	3.01	3.73	5.64	86.56
A14 (Rep) [T=30]	0	0.17	1.24	2.25	4.76	4.11	87.47
A15 [T=90]	0	0	1.11	3.22	4.65	5.23	85.79
A15 (Rep) [T=30]	0	0.15	0.95	4.33	4.66	5.42	84.49
A16 [T=30]	0	0.29	1.23	3.25	5.26	4.19	85.78
A17 [T=80]	0	0	1.78	2.86	5.95	5.19	84.22
A18 [T=145]	0	0.27	2.01	2.73	5.85	6.15	82.99
A19 [T=200]	0	0.33	1.92	2.80	3.11	6.63	85.21
A20 [T=30]	0	0.32	0.98	1.95	4.70	5.02	87.03

SIZE ANALYSIS OF FEED SAMPLES: TEST A [TEST AA1-AA3]

SAMPLE I.D.	SCREEN SIZE [MICRON]						
	+ 600	250	150	106	75	45	-45
Test AA1 [T=30]	0	0.44	1.22	2.15	3.28	4.37	88.54
AA1 [T=95]	0	0.25	1.10	2.02	4.11	4.42	88.10
AA1 [T=165]	0	0.17	0.98	2.02	3.75	5.32	87.76
AA1 [T=210]	0	0.26	0.85	1.68	3.36	4.93	88.92
AA1 [T=290]	0	0.33	1.12	2.29	3.65	6.12	86.49
AA1 [T=365]	0	0.20	1.21	2.10	3.65	5.16	87.68
AA2 [T=30]	0	0.13	0.83	1.76	2.58	4.93	89.78
AA2 [T=90]	0	0	1.12	1.95	2.33	4.73	89.87
AA3 [T=30]	0	0.12	1.02	2.10	5.66	7.42	83.68
AA3 [T=100]	0	0.27	0.95	2.32	5.42	6.20	84.84

APPENDIX C

[LABORATORY AND FIELD TESTING FLOCCULATION PERFORMANCE CURVES]

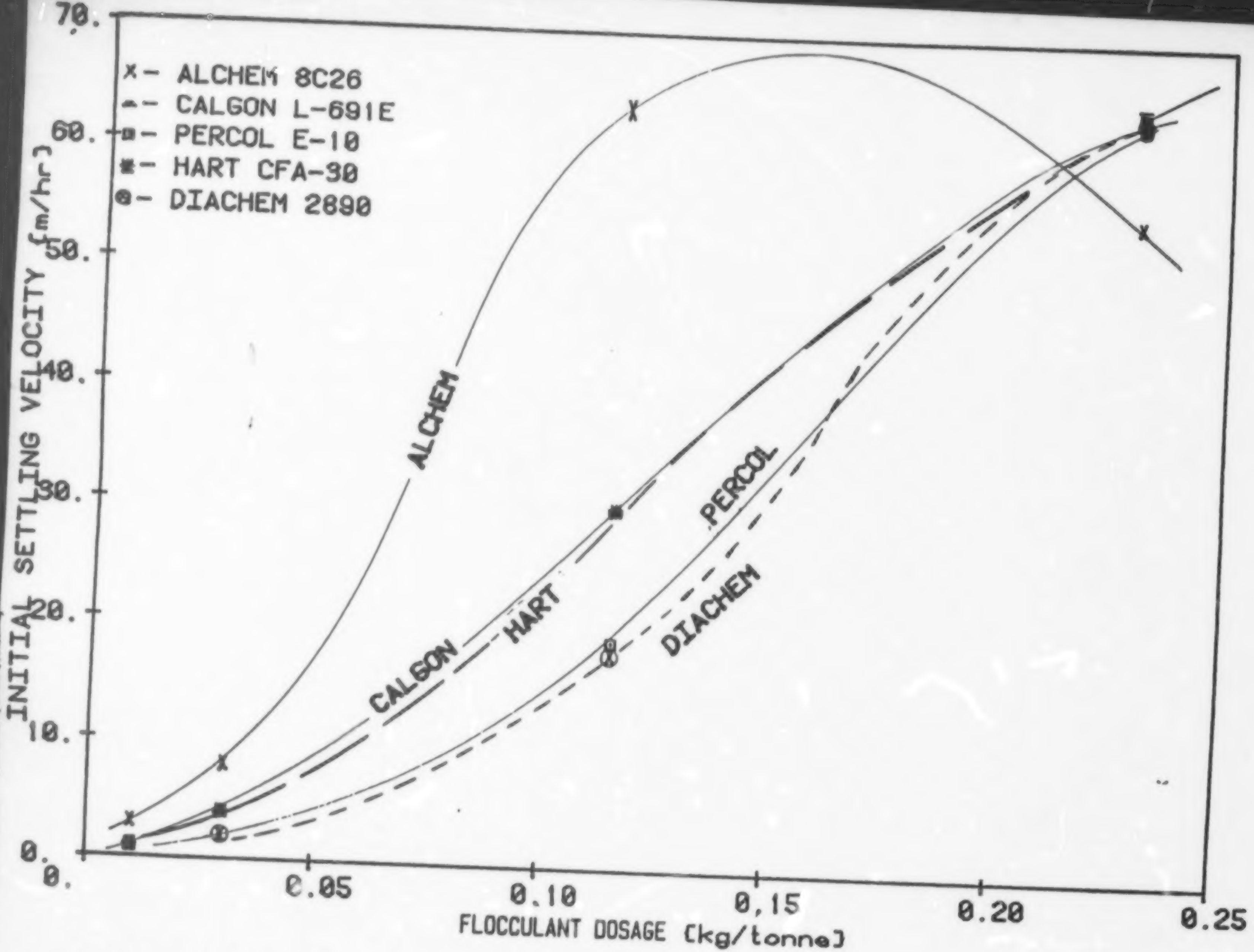


FIG. 1 SETTLING CURVES FOR THE COMPARISON OF ANIONIC FLOCCULANTS.
(APPENDIX – C)

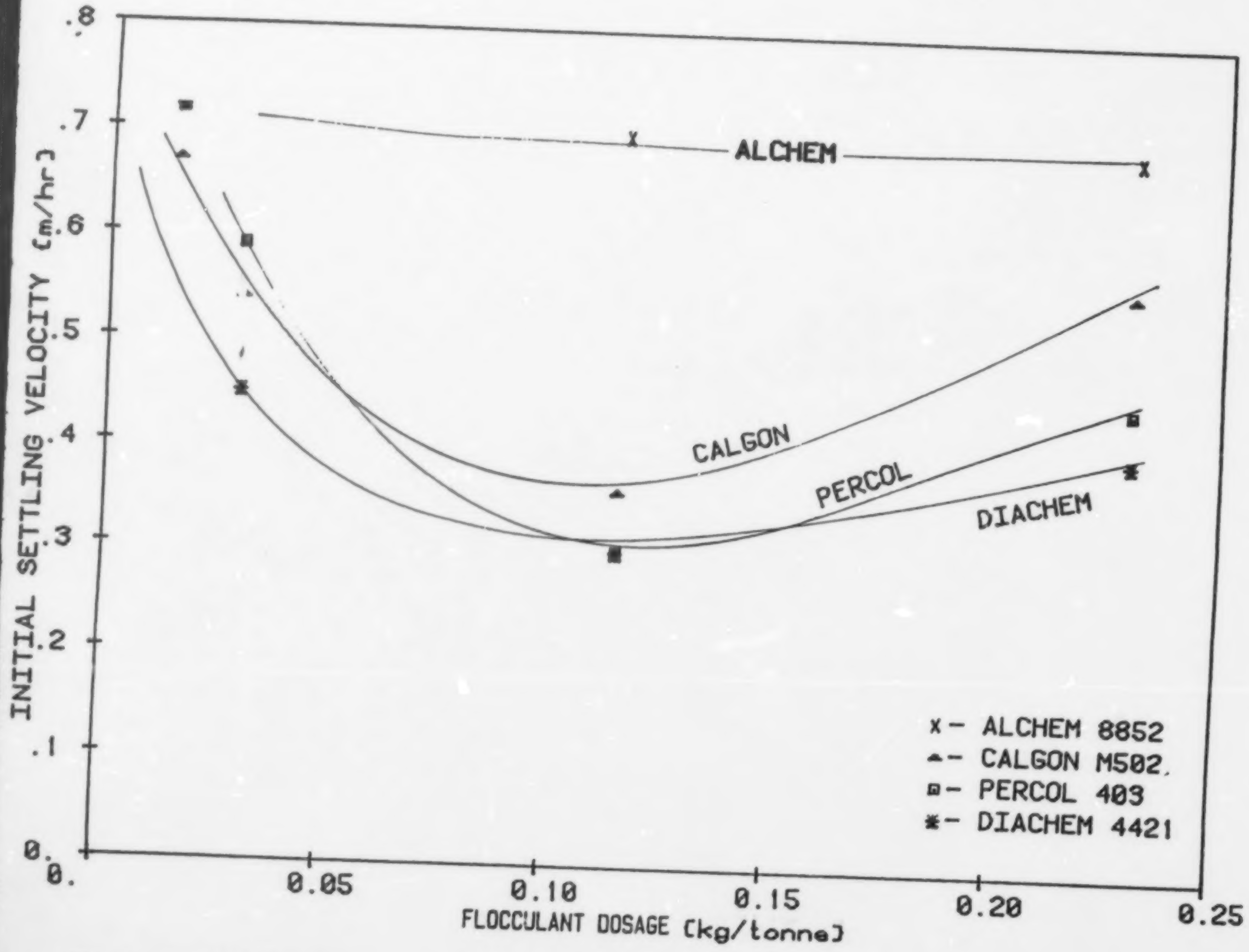


FIG. 2 SETTLING CURVES FOR THE COMPARISON OF CATIONIC FLOCCULANTS.
(APPENDIX - C)

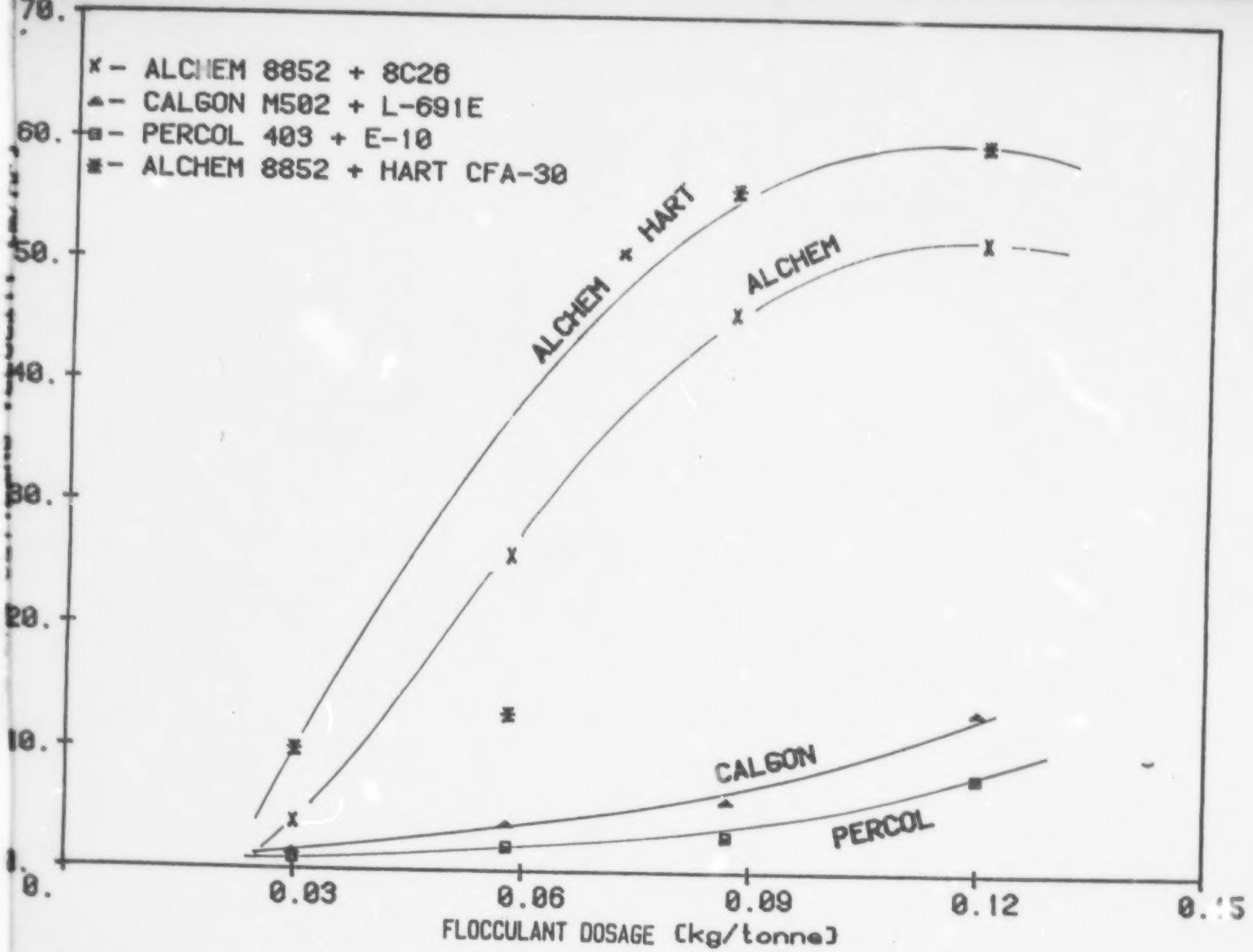


FIG. 3 SETTLING CURVES FOR THE COMPARISON OF CATIONIC PLUS ANIONIC FLOCCULANTS. (APPENDIX - C)

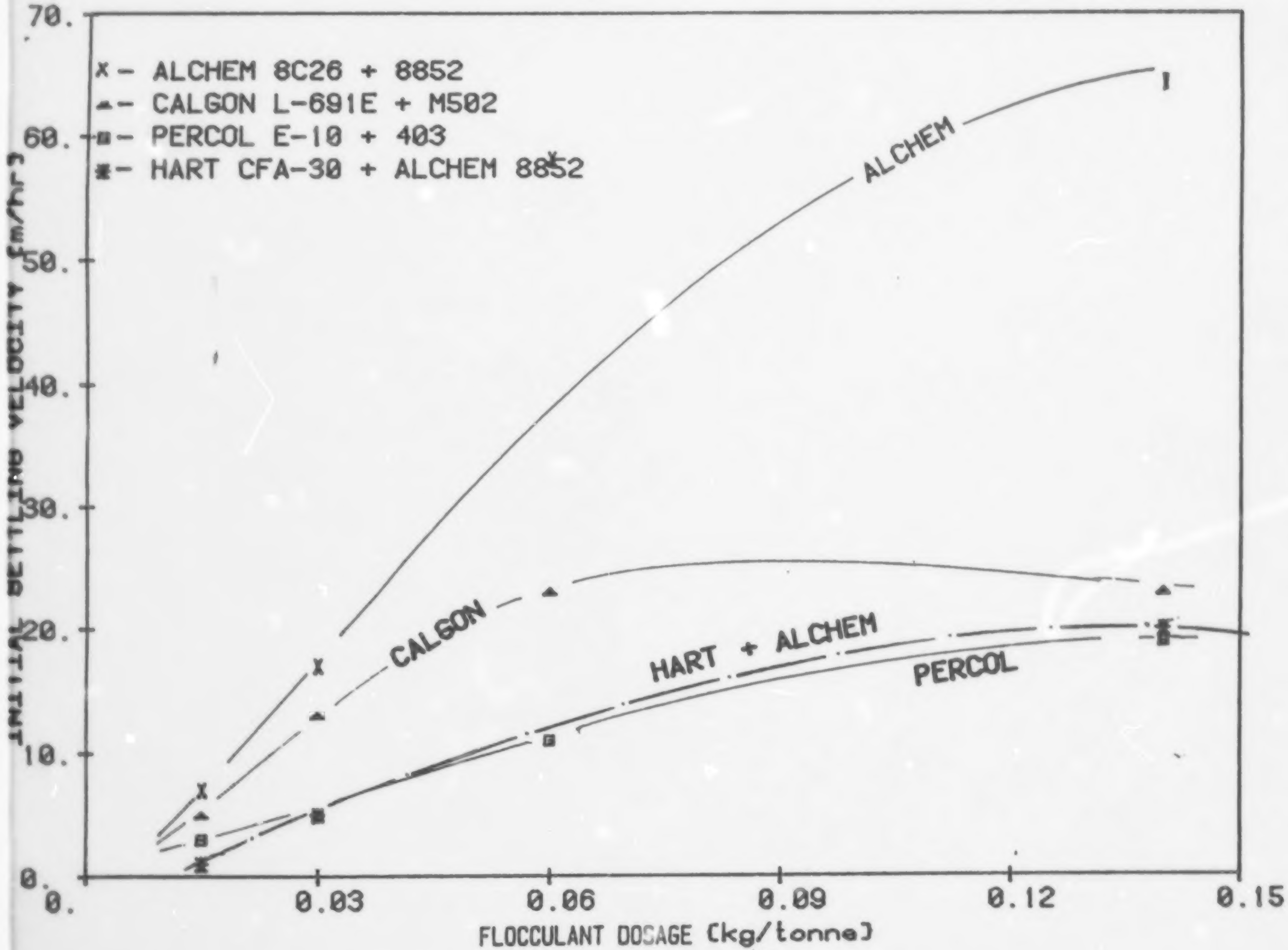


FIG. 4 SETTLING CURVES FOR THE COMPARISON OF ANIONIC PLUS CATIONIC FLOCCULANTS.

(APPENDIX - C)

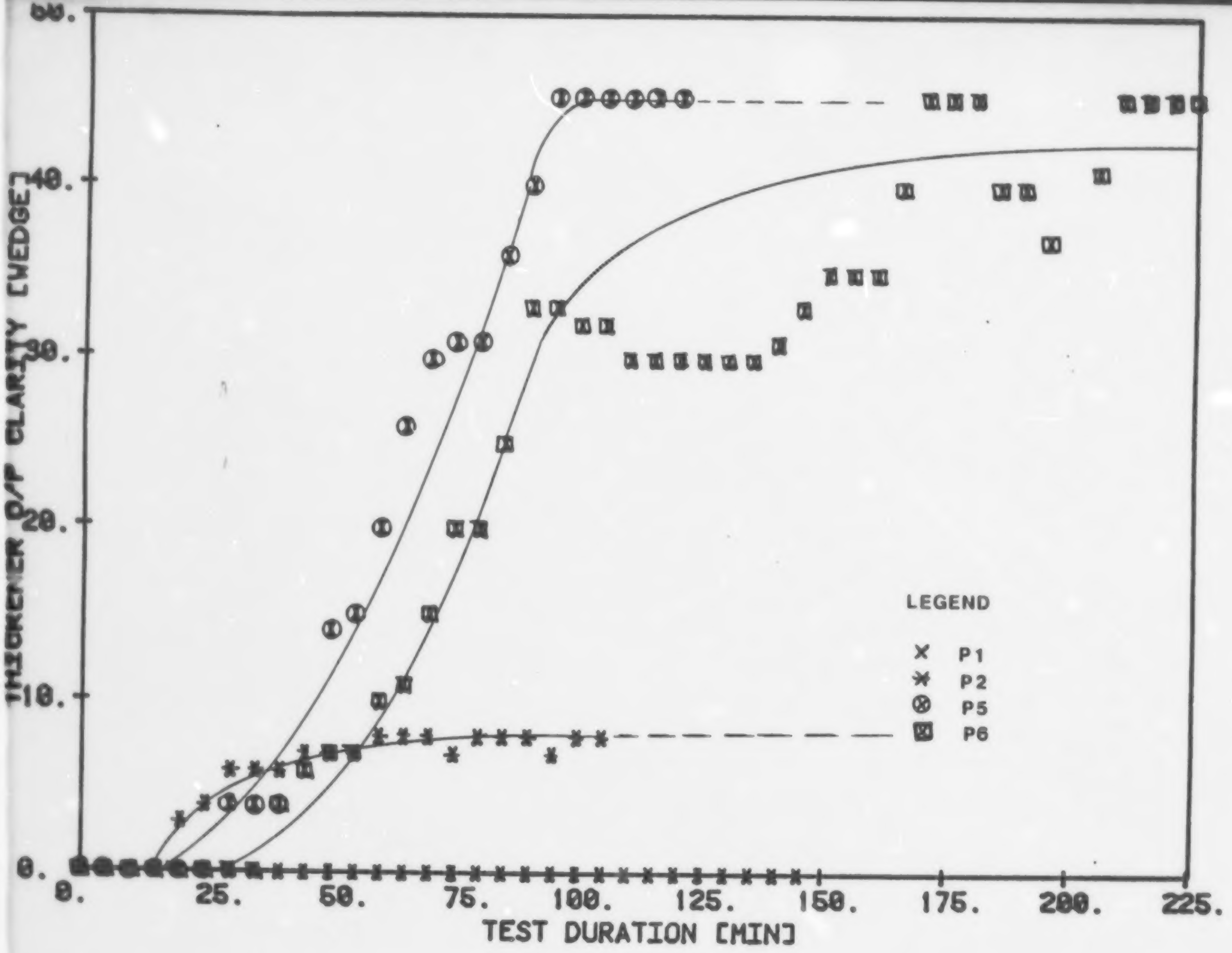


FIG. 5 MOBILE PLANT THICKENER PERFORMANCE - CLARIFICATION DATA (TEST-P OBED).
(APPENDIX - C)

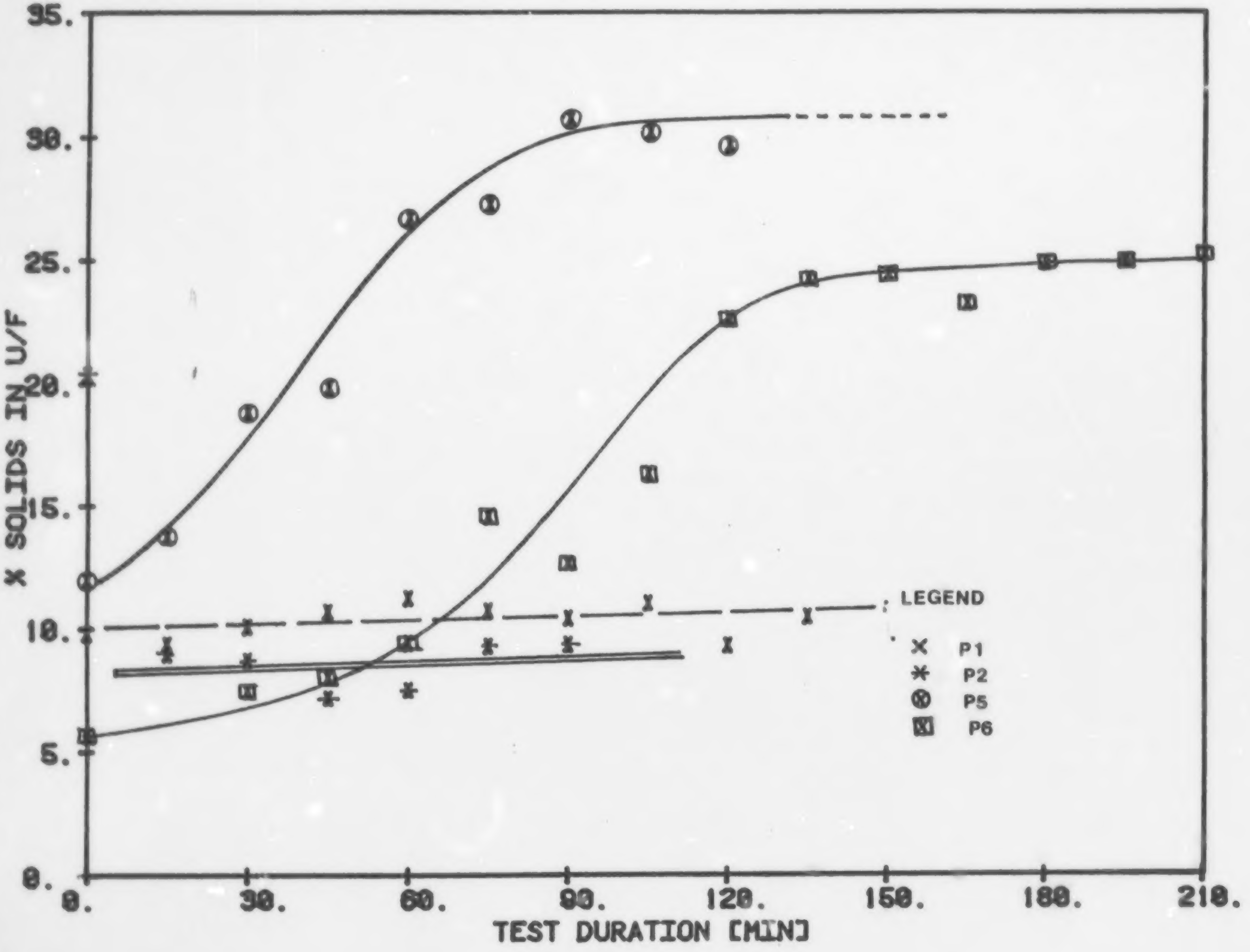


FIG. 6 MOBILE PLANT THICKENER PERFORMANCE - THICKENING DATA (TEST-P OBED).
(APPENDIX - C)

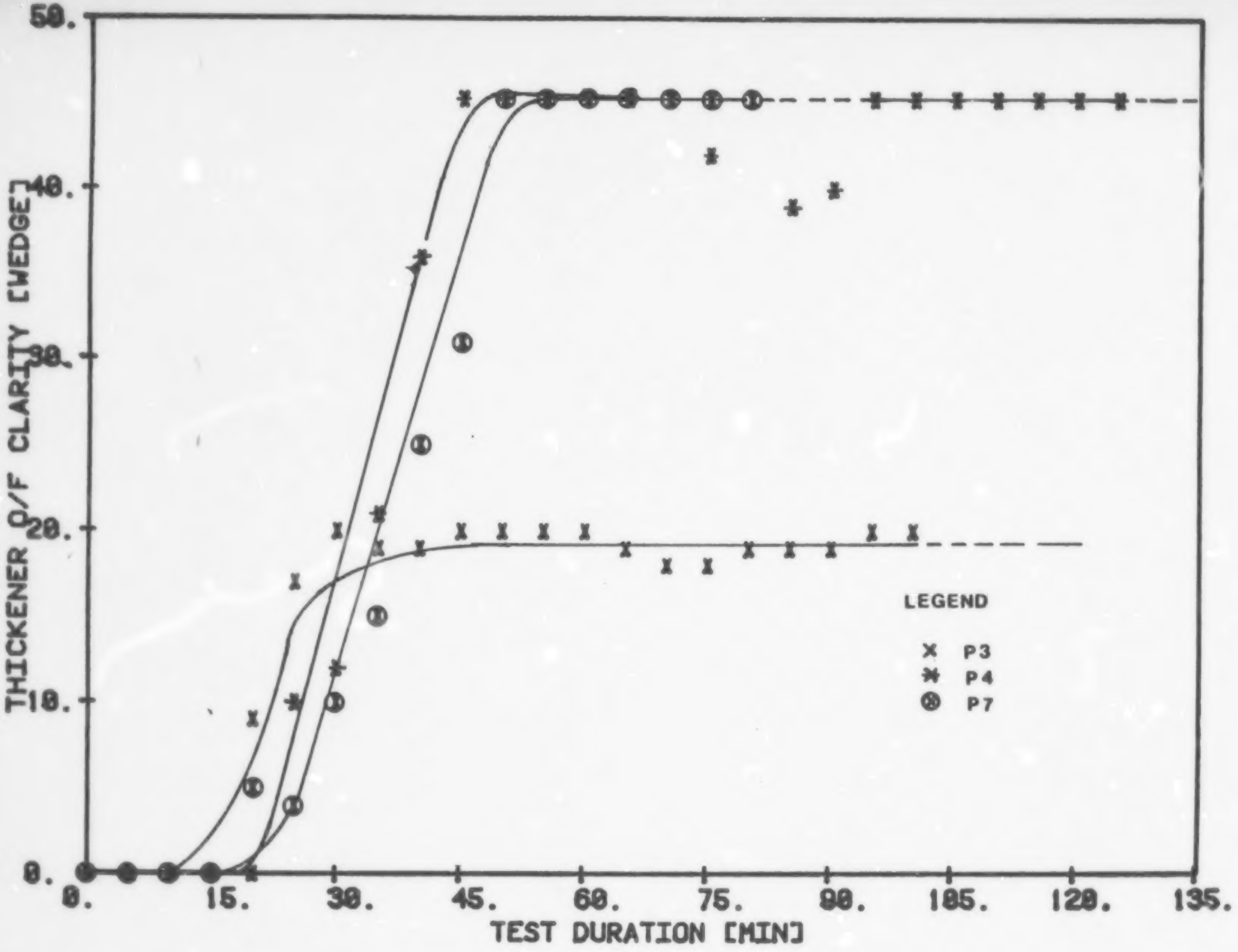


FIG. 7 MOBILE PLANT THICKENER PERFORMANCE - CLARIFICATION DATA (TEST-P OBED).
(APPENDIX - C)

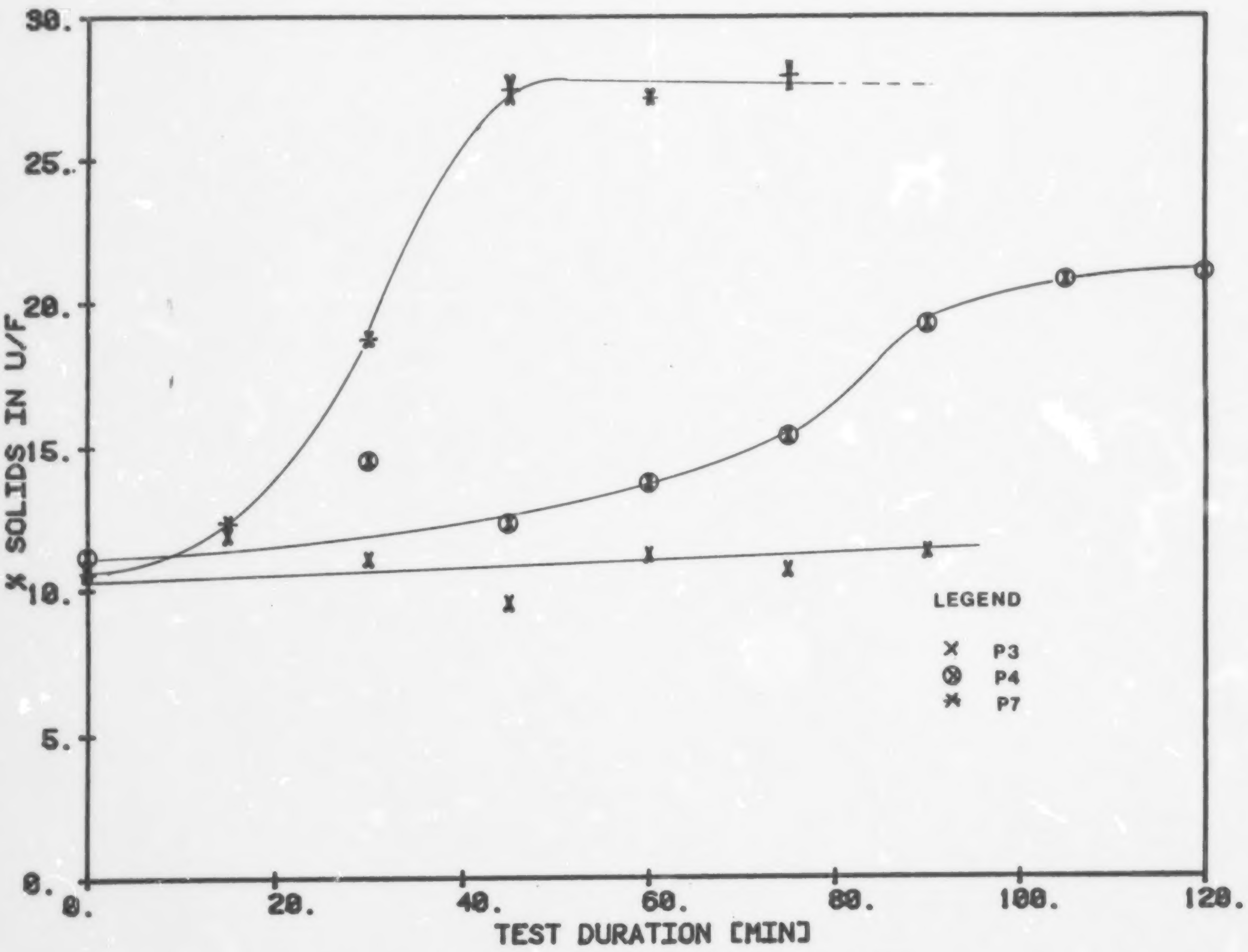


FIG. 8 MOBILE PLANT THICKENER PERFORMANCE - THICKENING DATA (TEST-P OBED).
(APPENDIX - C)

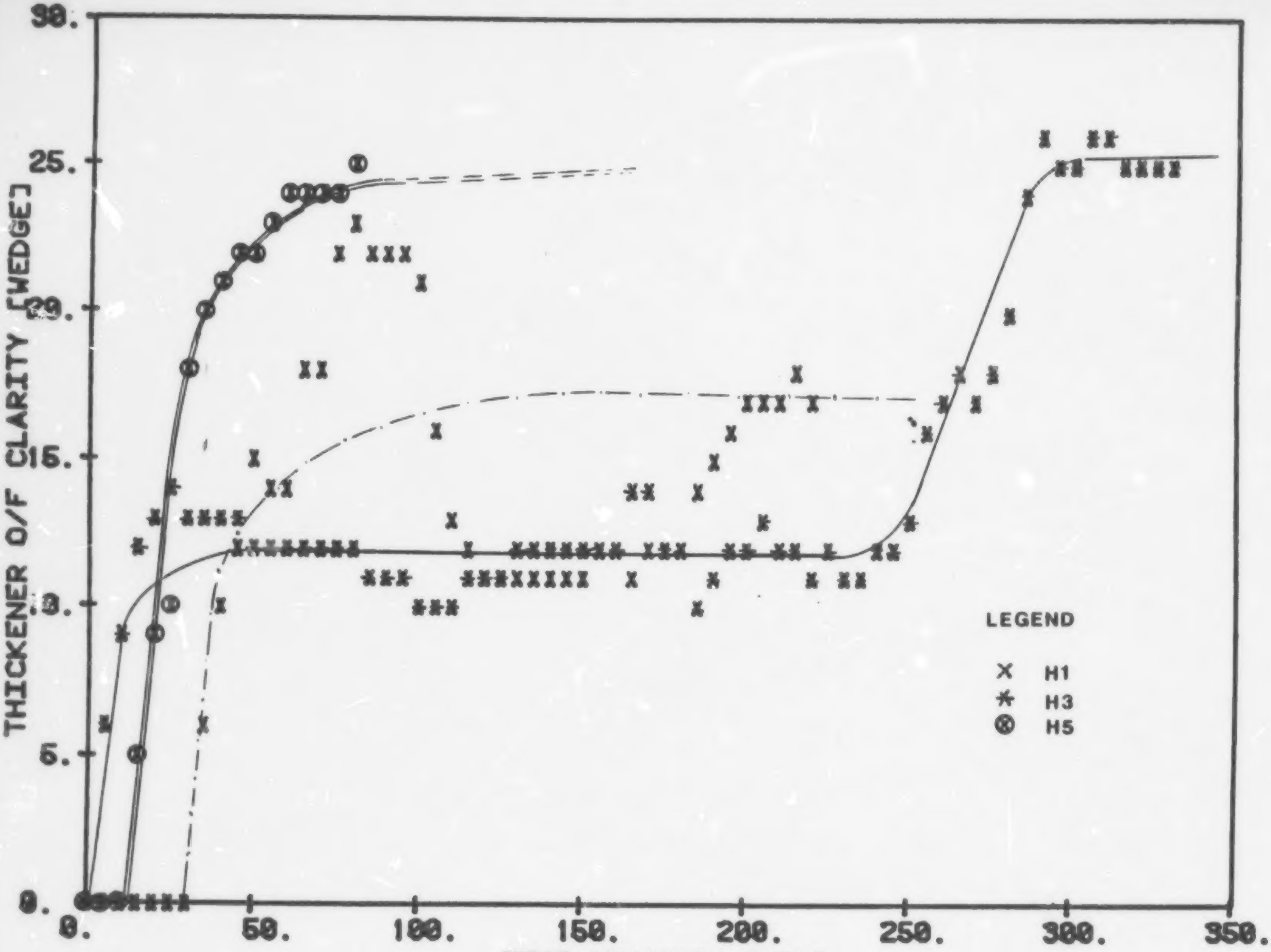


FIG. 9 MOBILE PLANT THICKENER PERFORMANCE - CLARIFICATION DATA (TEST-H OBED).
(APPENDIX - C)

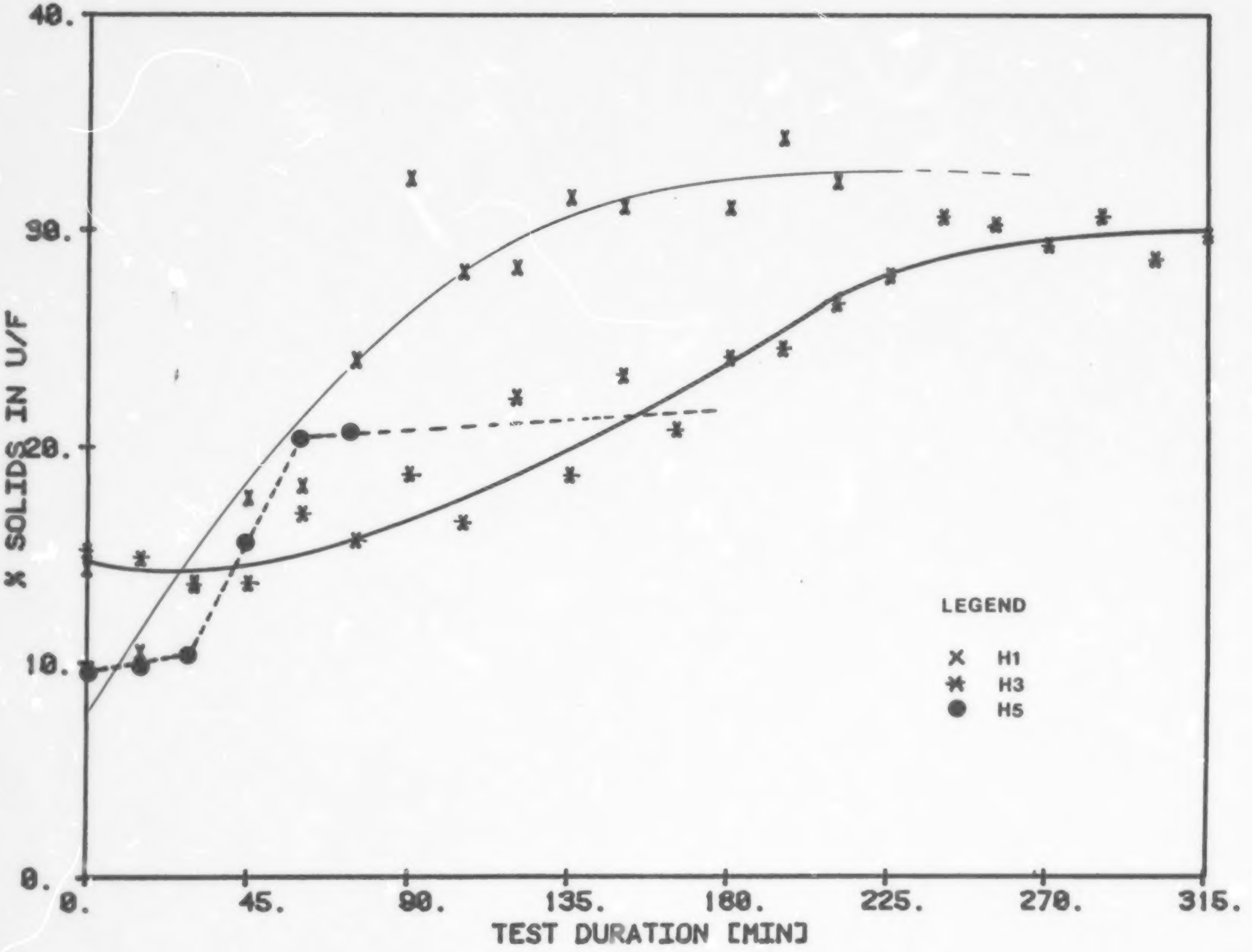


FIG. 10 MOBILE PLANT THICKENER PERFORMANCE - THICKENING DATA (TEST-H OBED).

(APPENDIX - C)

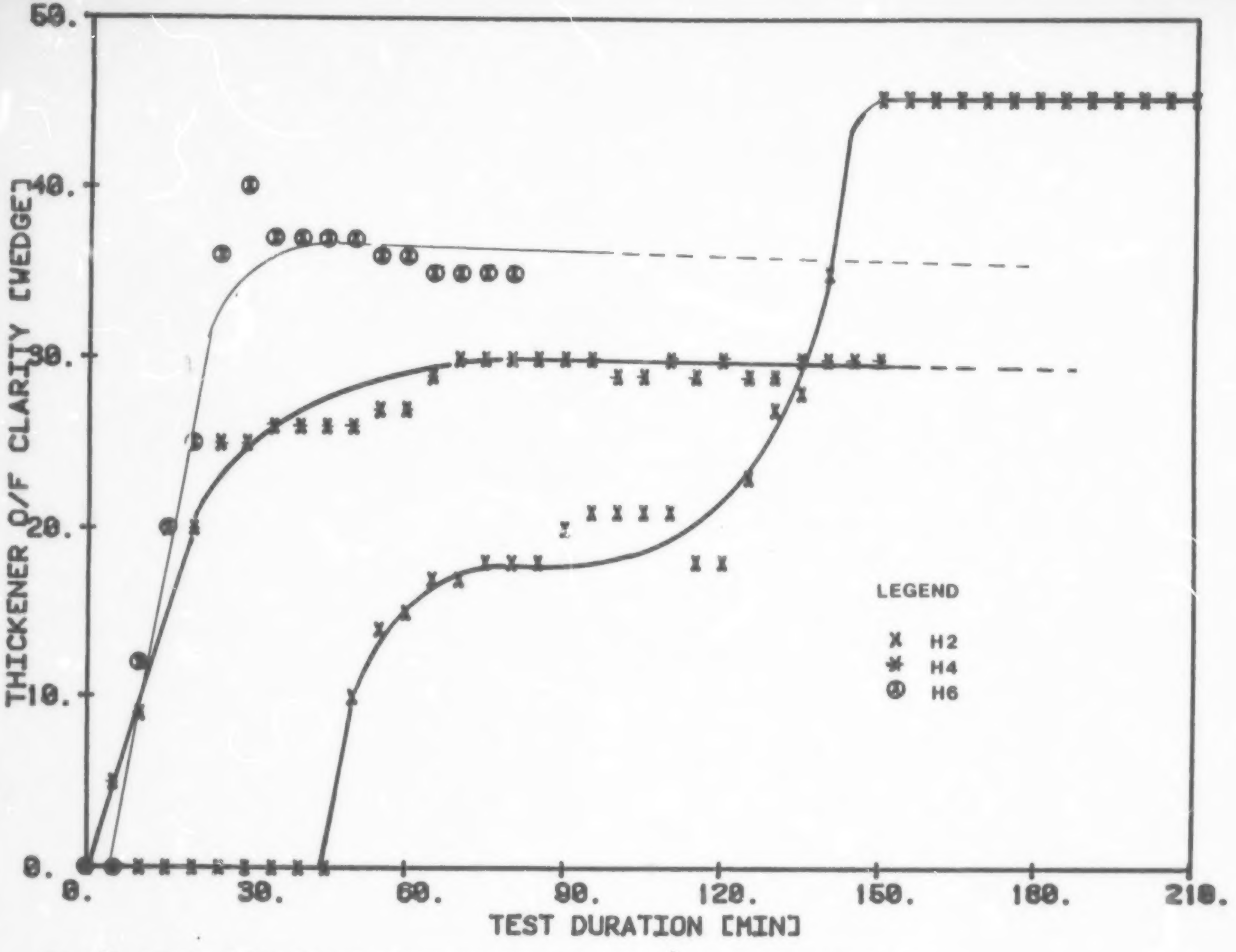


FIG. 11 MOBILE PLANT THICKENER PERFORMANCE - CLARIFICATION DATA (TEST-H OBED).
(APPENDIX - C)

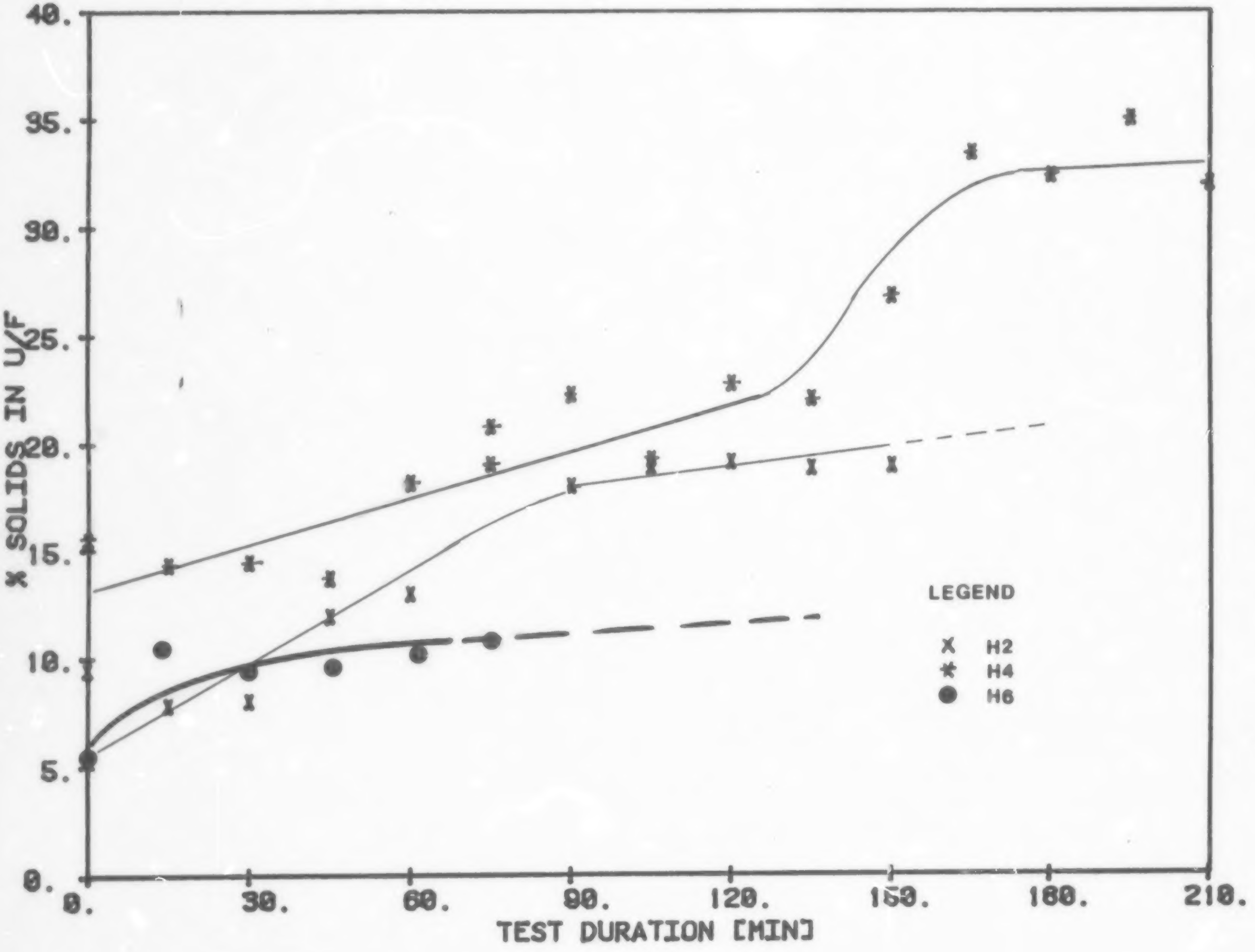


FIG. 12 MOBILE PLANT THICKENER PERFORMANCE - THICKENING DATA (TEST-H OBED).
(APPENDIX - C)

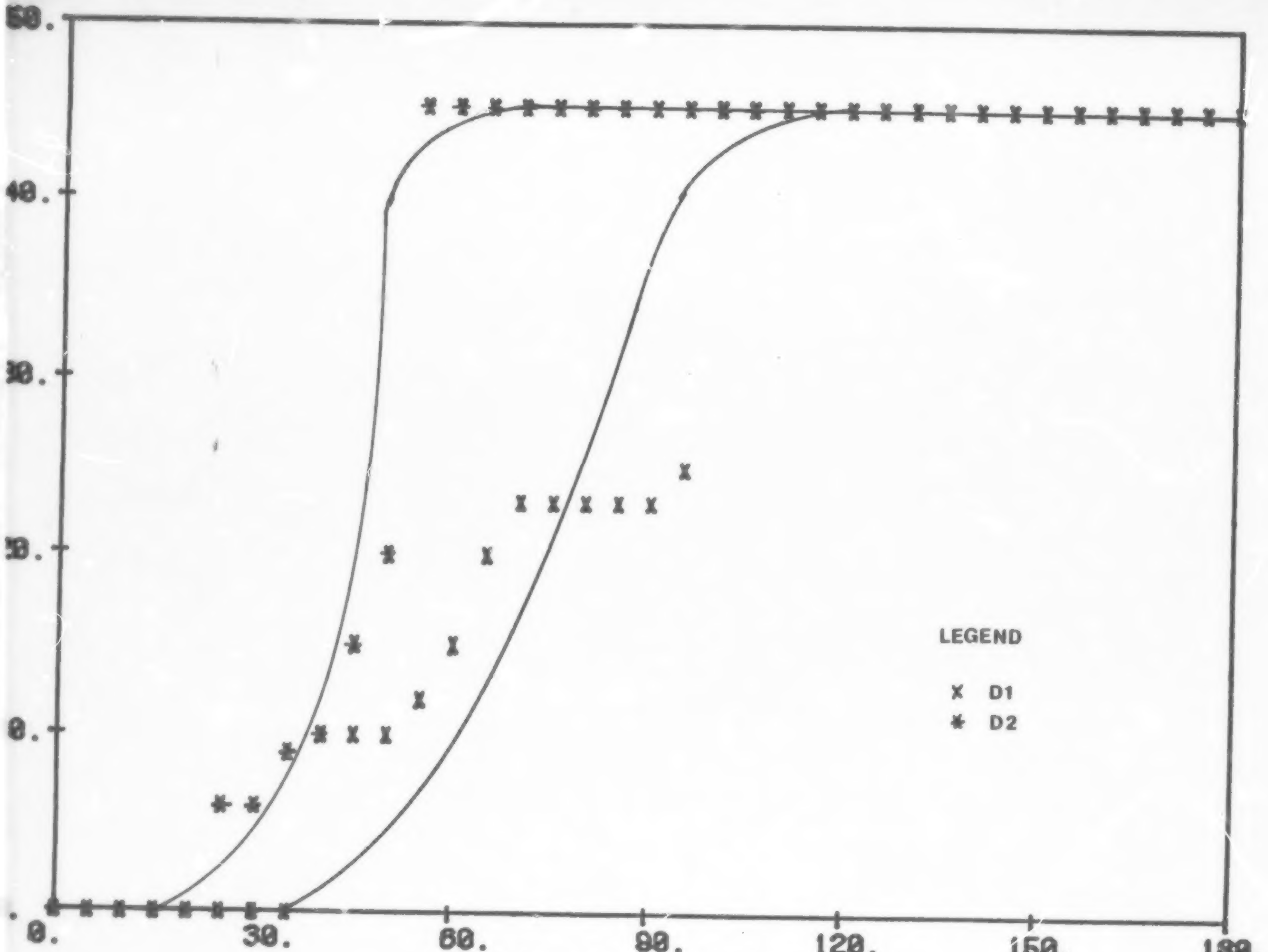


FIG. 13 MOBILE PLANT THICKENER PERFORMANCE - CLARIFICATION DATA (TEST-D OBED).
(APPENDIX - C)

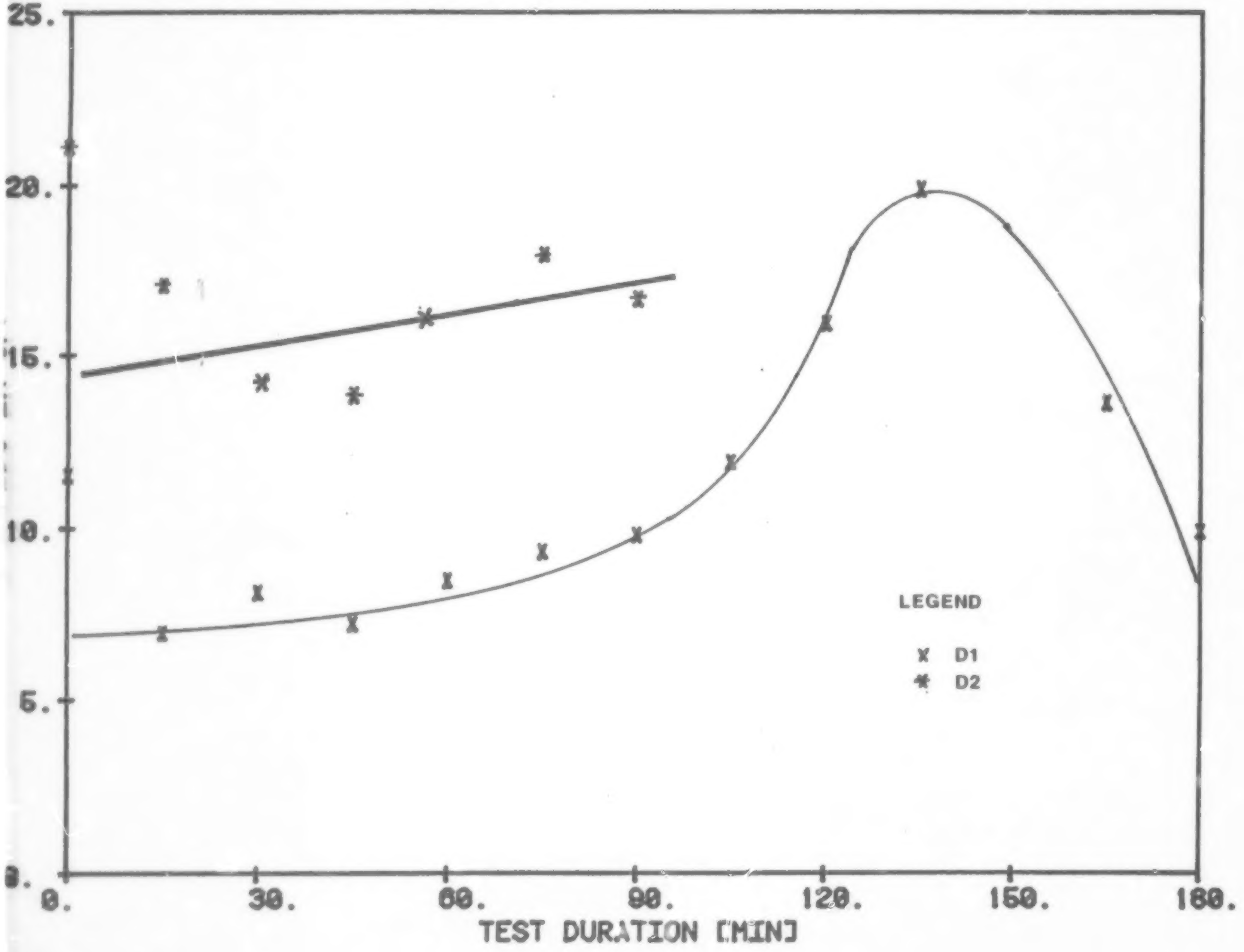


FIG. 14 MOBILE PLANT THICKENER PERFORMANCE - THICKENING DATA (TEST-D OBED).
(APPENDIX - C)

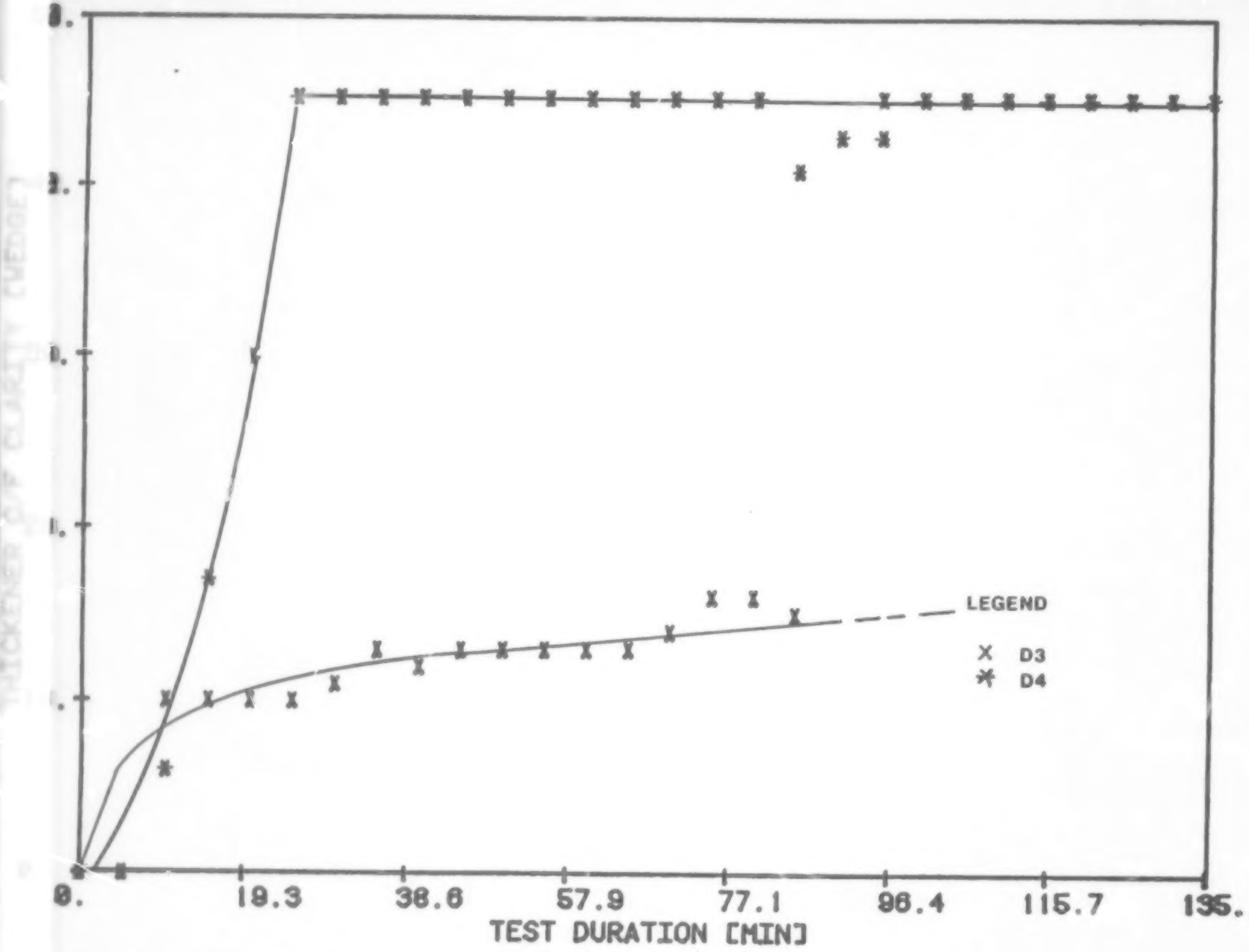


FIG. 15 MOBILE PLANT THICKENER PERFORMANCE - CLARIFICATION DATA (TEST-D OBED).

(APPENDIX - C)

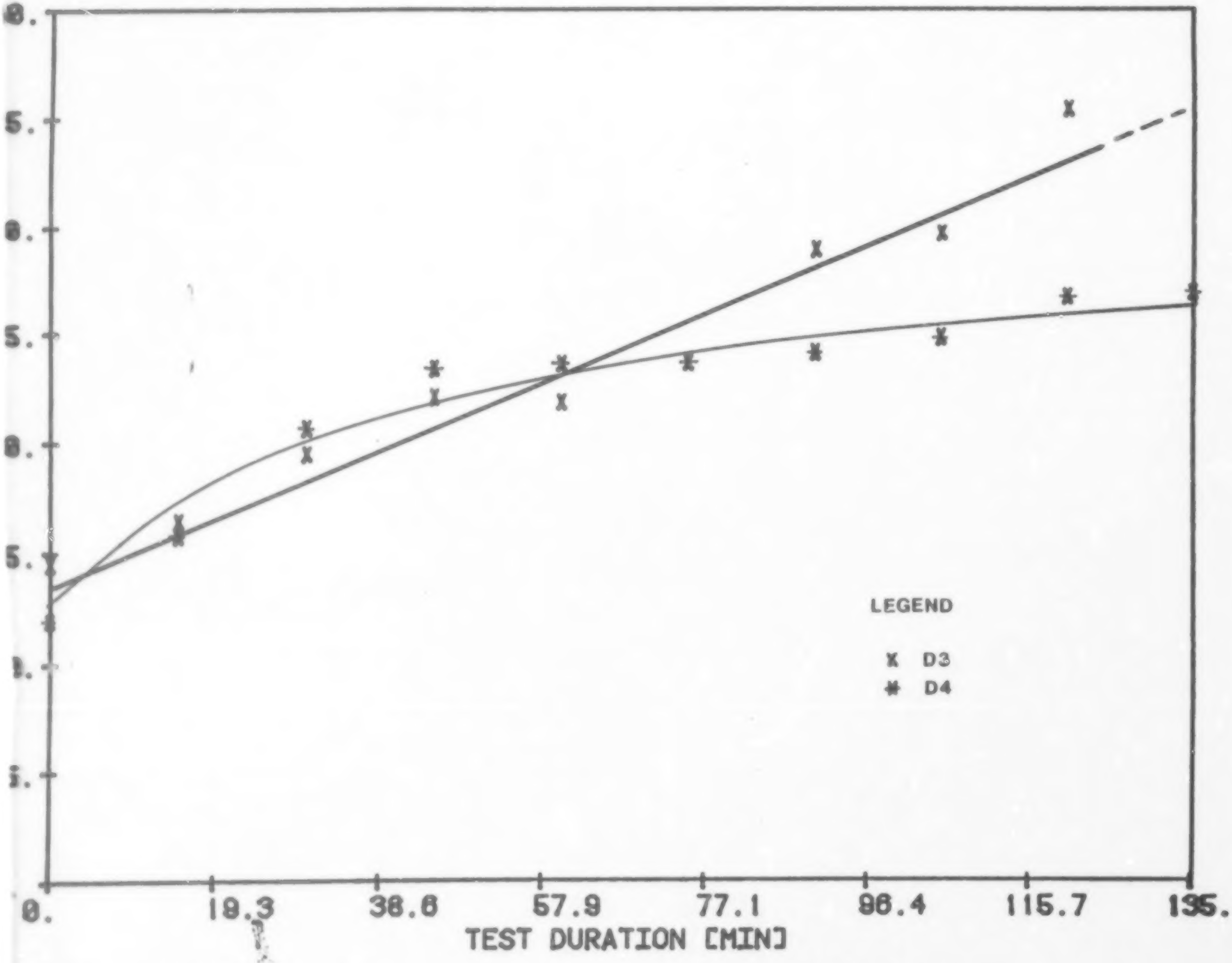


FIG. 16 MOBILE PLANT THICKENER PERFORMANCE - THICKENING DATA (TEST- D OBED).

(APPENDIX - C)

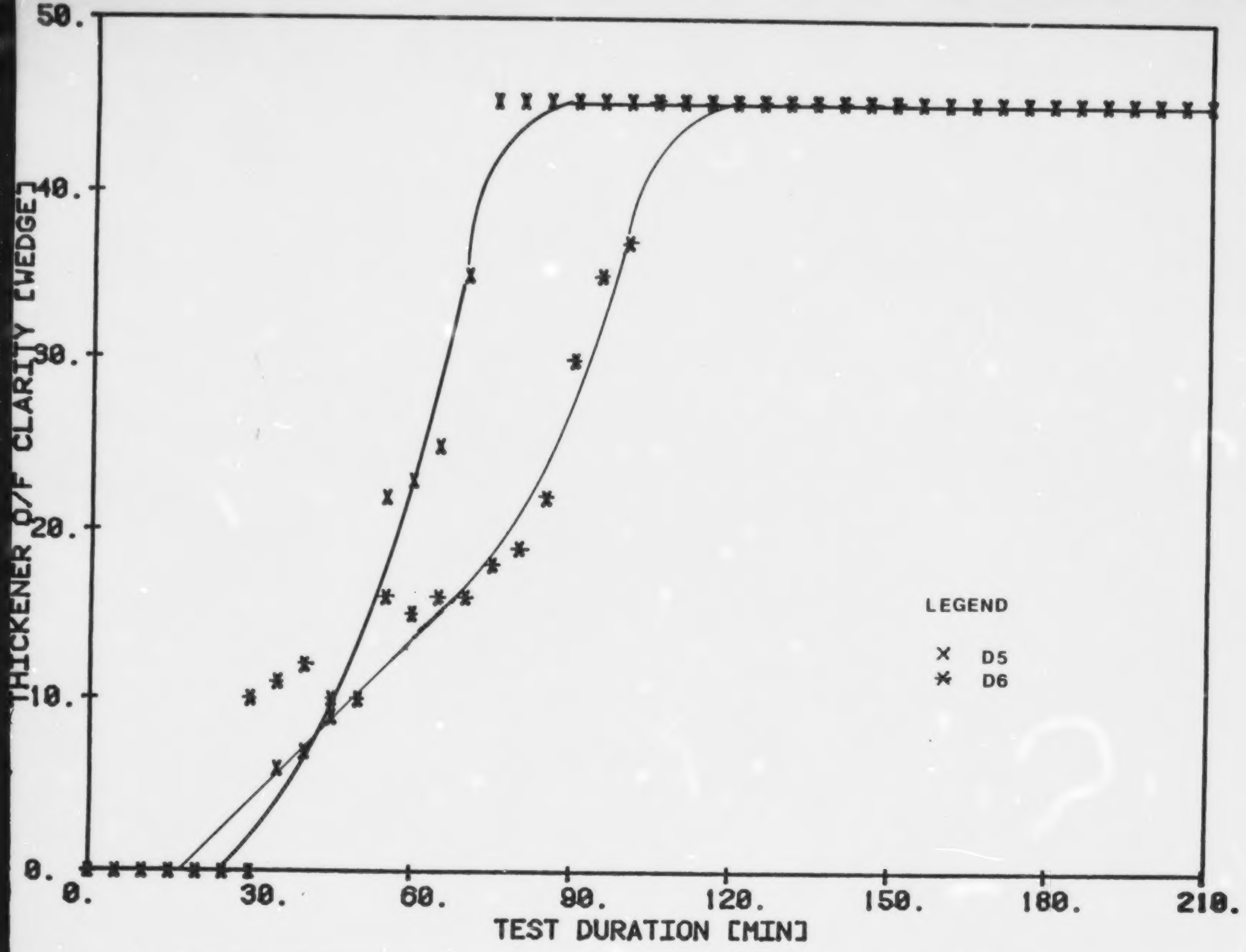


FIG. 17 MOBILE PLANT THICKENER PERFORMANCE - CLARIFICATION DATA (TEST-D OBED).

(APPENDIX - C)

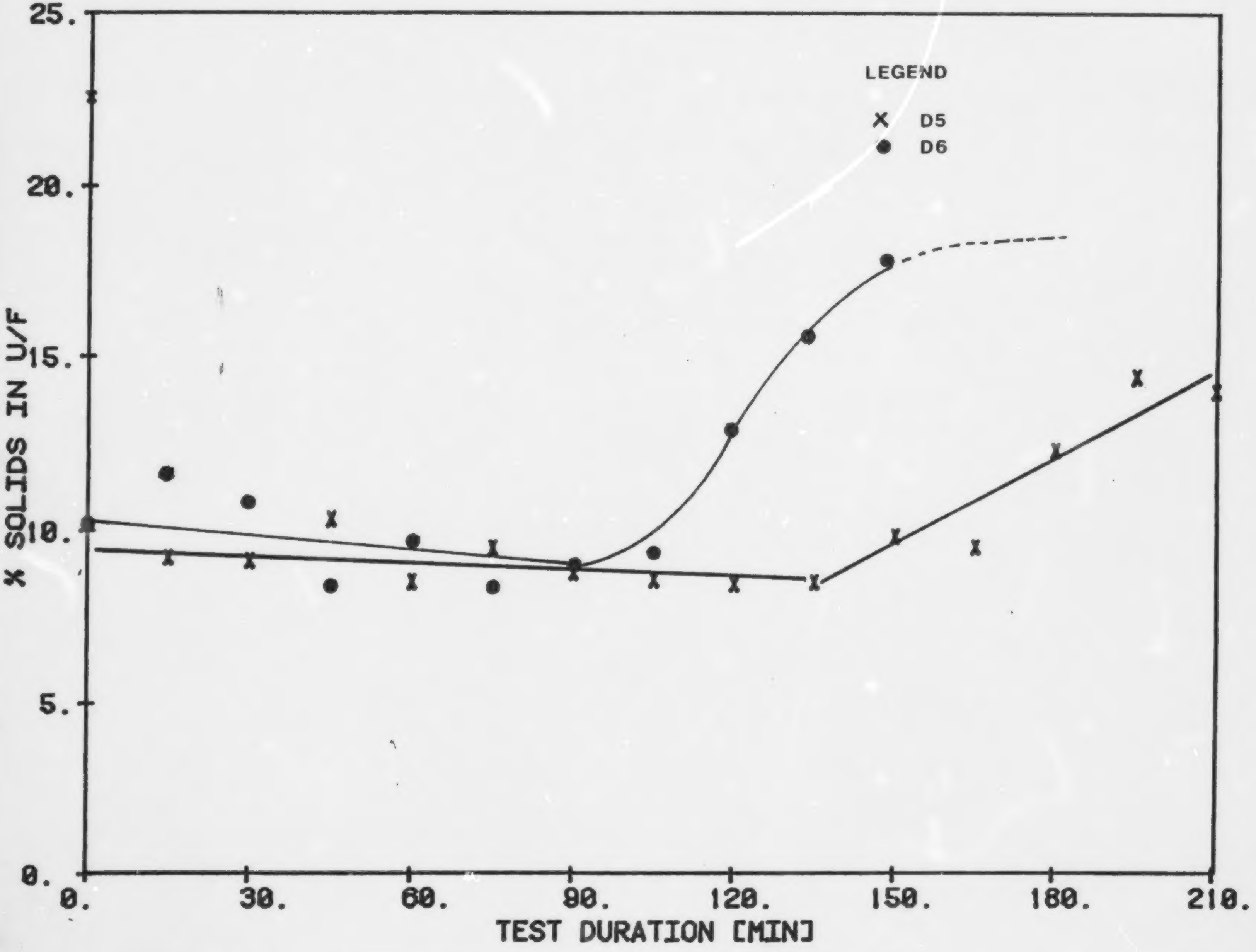


FIG. 18 MOBILE PLANT THICKENER PERFORMANCE - THICKENING DATA (TEST-D OBED).
(APPENDIX - C)

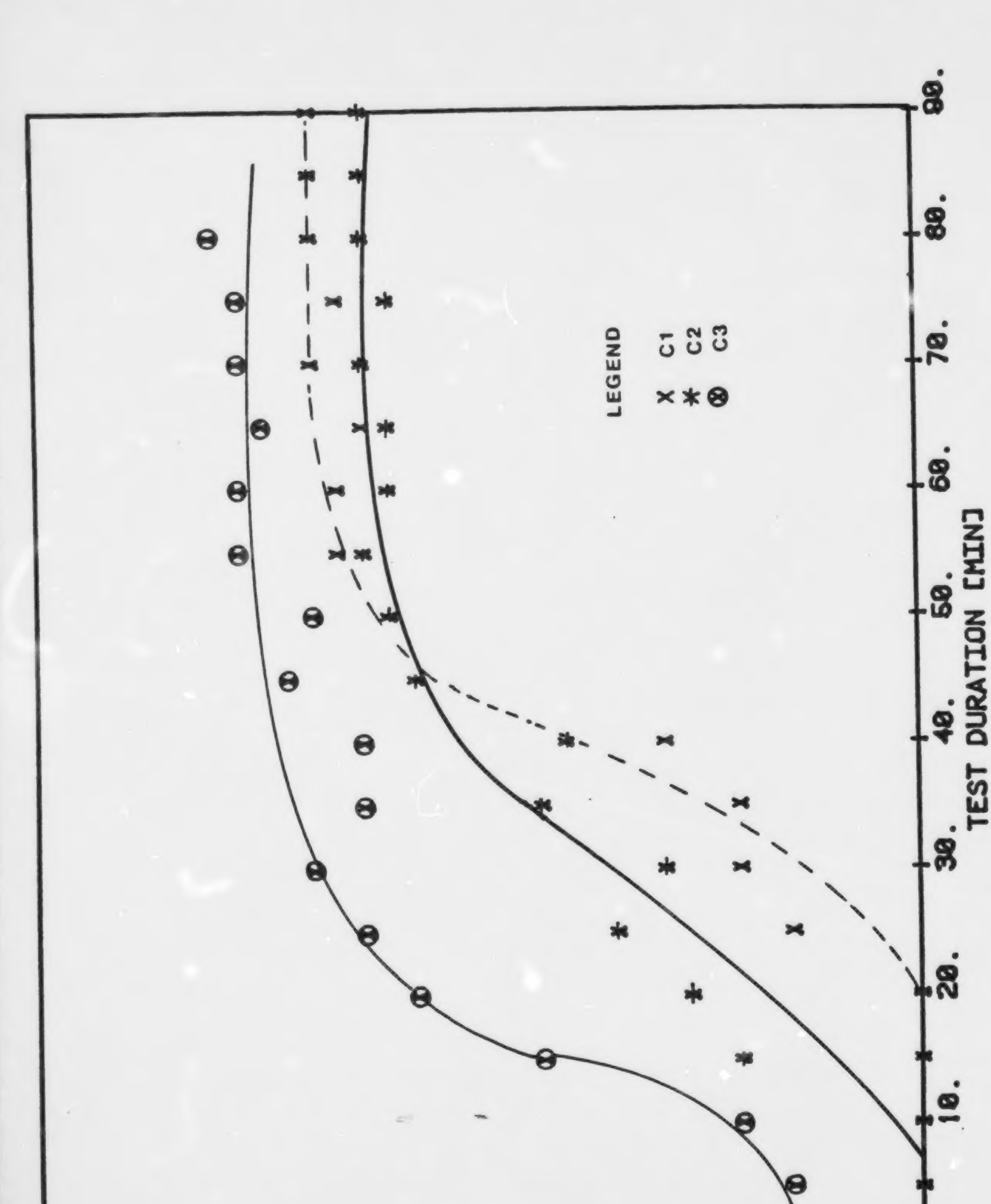


FIG. 19 MOBILE PLANT THICKENER PERFORMANCE - CLARIFICATION DATA (TEST-C OBED).

(APPENDIX - C)

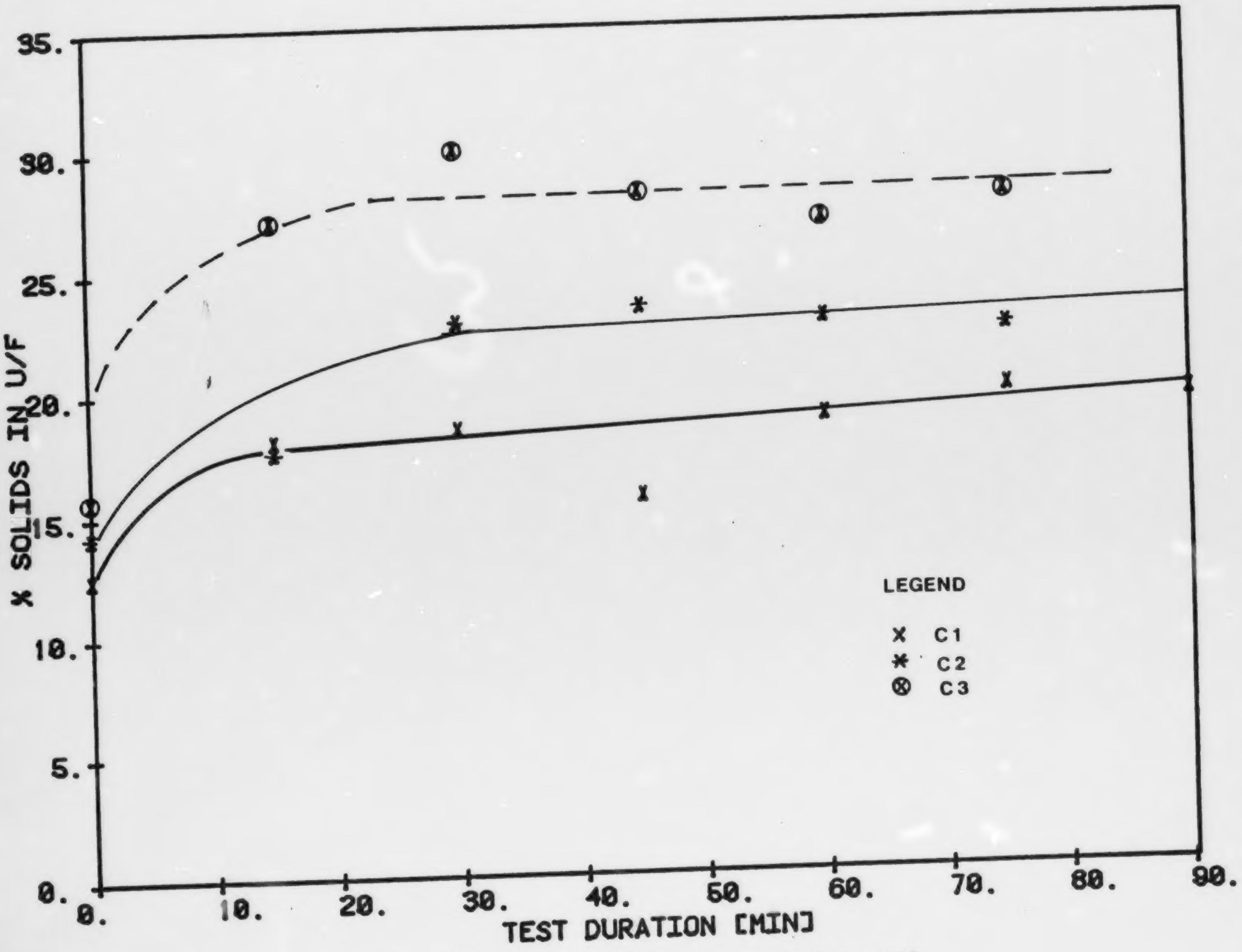


FIG. 20 MOBILE PLANT THICKENER PERFORMANCE - THICKENING DATA (TEST-C OBED).

(APPENDIX - C)

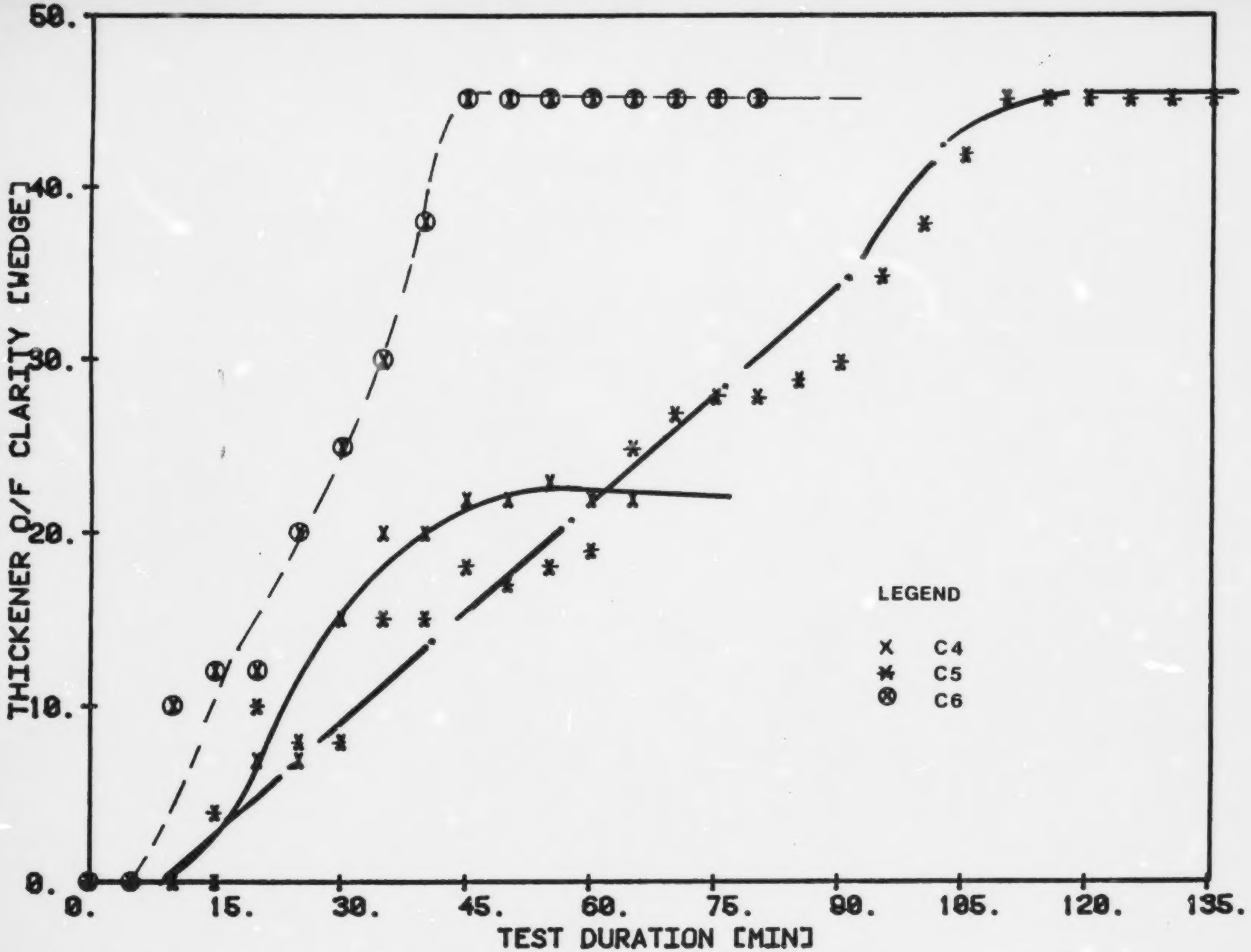


FIG. 21 MOBILE PLANT THICKENER PERFORMANCE - CLARIFICATION DATA (TEST-C OBED).

(APPENDIX - C)

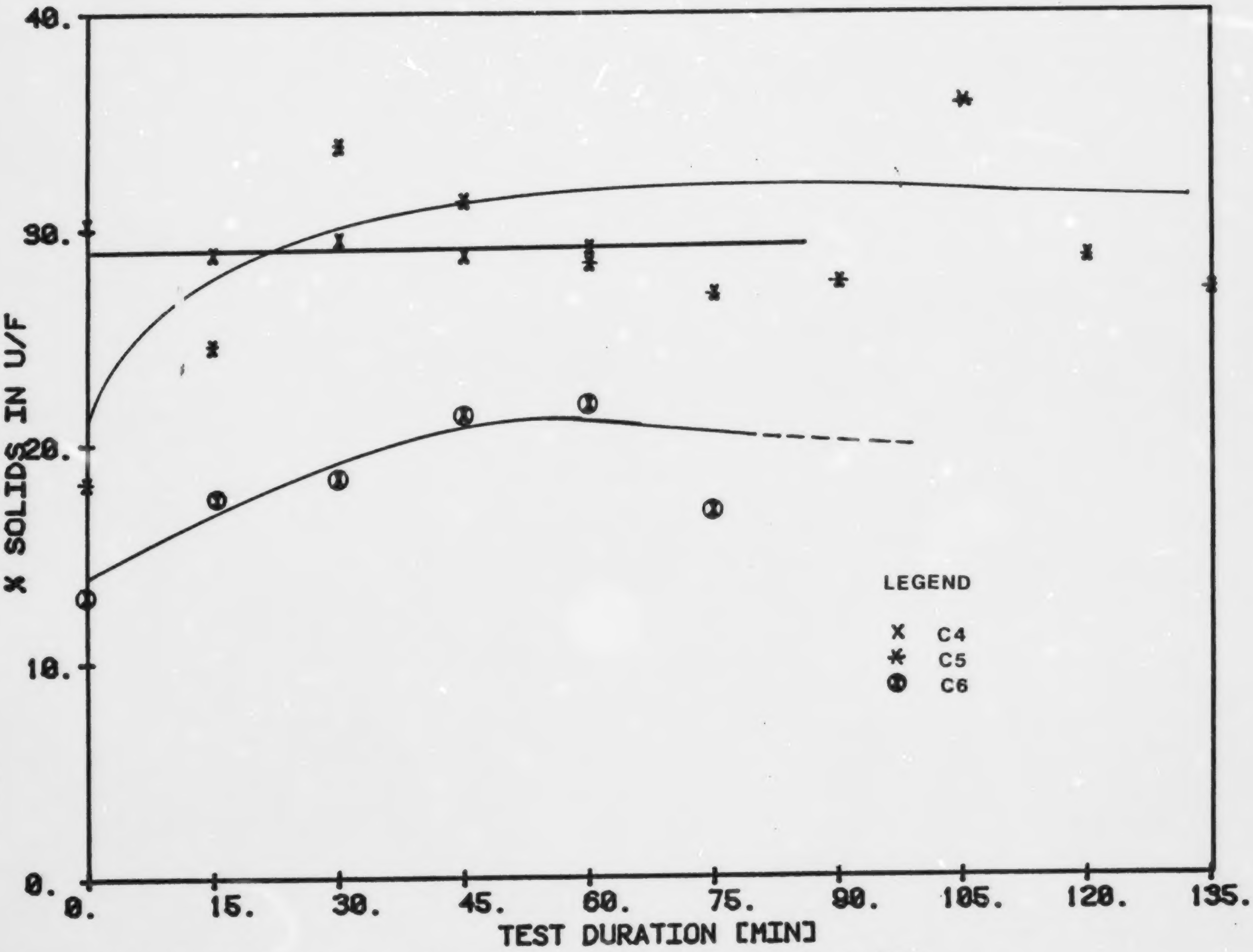


FIG. 22 MOBILE PLANT THICKENER PERFORMANCE - THICKENING DATA (TEST-C OBED).
(APPENDIX - C)

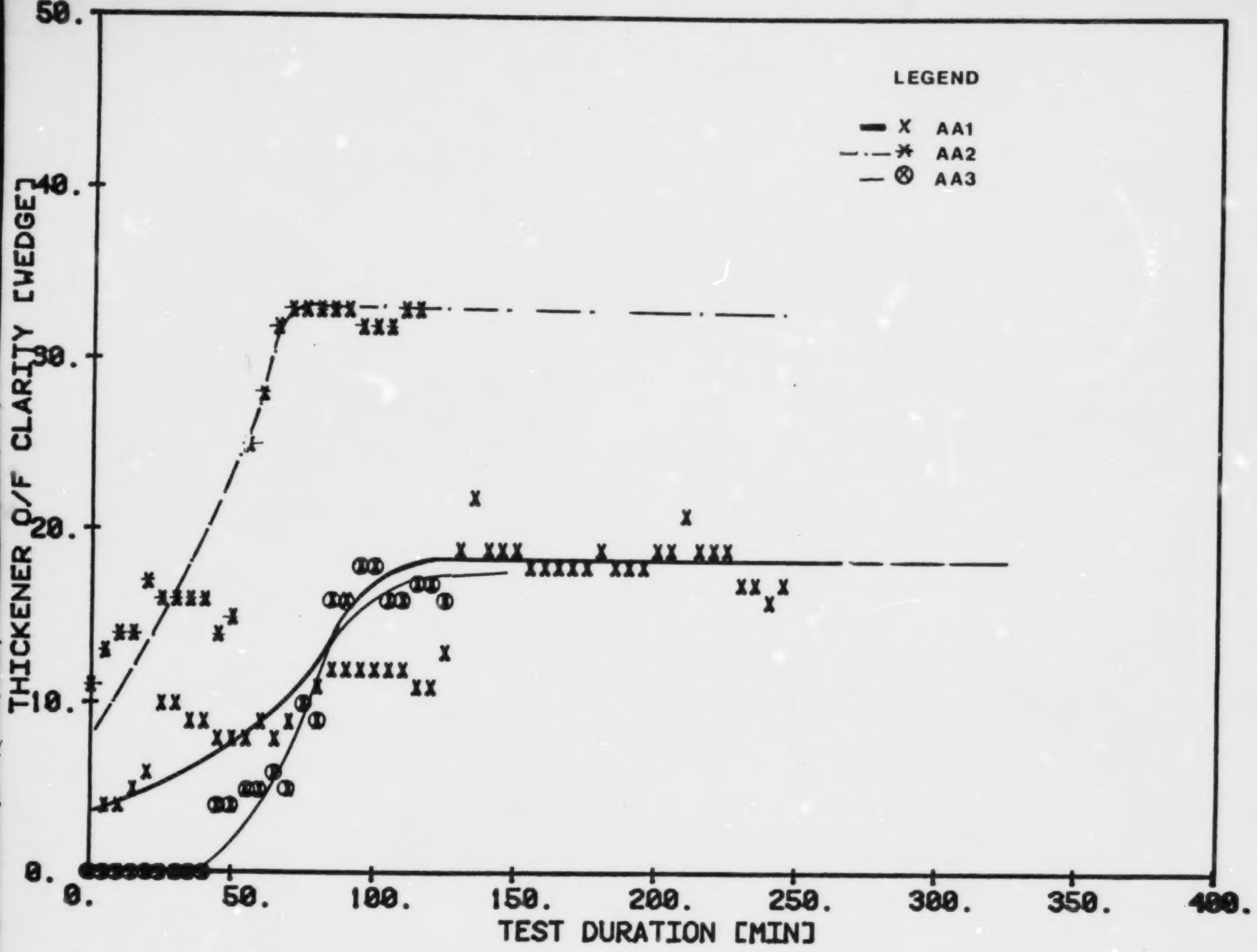


FIG. 23 MOBILE PLANT THICKENER PERFORMANCE - CLARIFICATION DATA (TEST-AA OBED).
(APPENDIX - C)

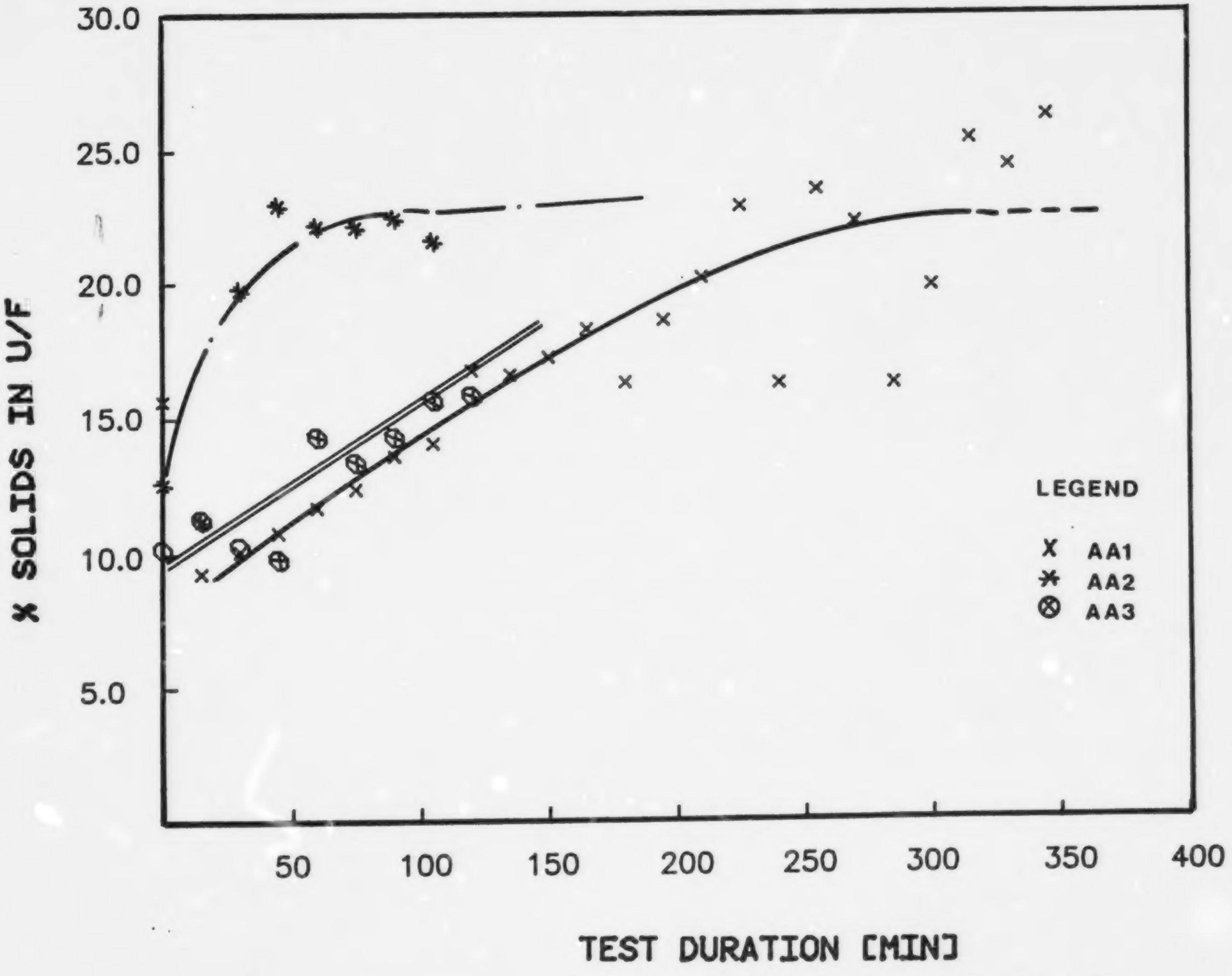


FIG. 24 MOBILE PLANT THICKENER PERFORMANCE- THICKENING DATA (TEST-AA OBED)
(APPENDIX -C)

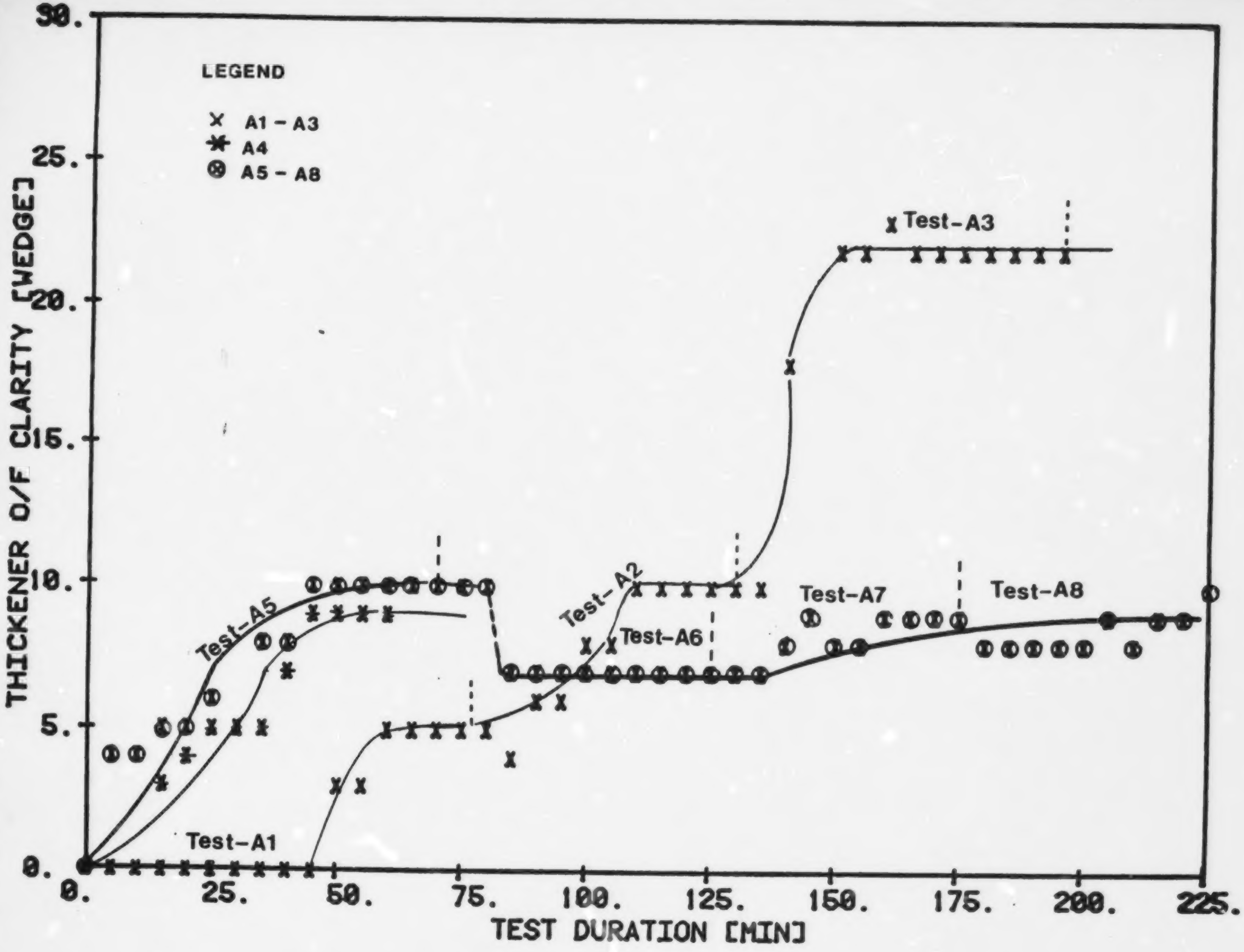


FIG. 25 MOBILE PLANT THICKENER PERFORMANCE - CLARIFICATION DATA (TEST-A OBED).

(APPENDIX - C)

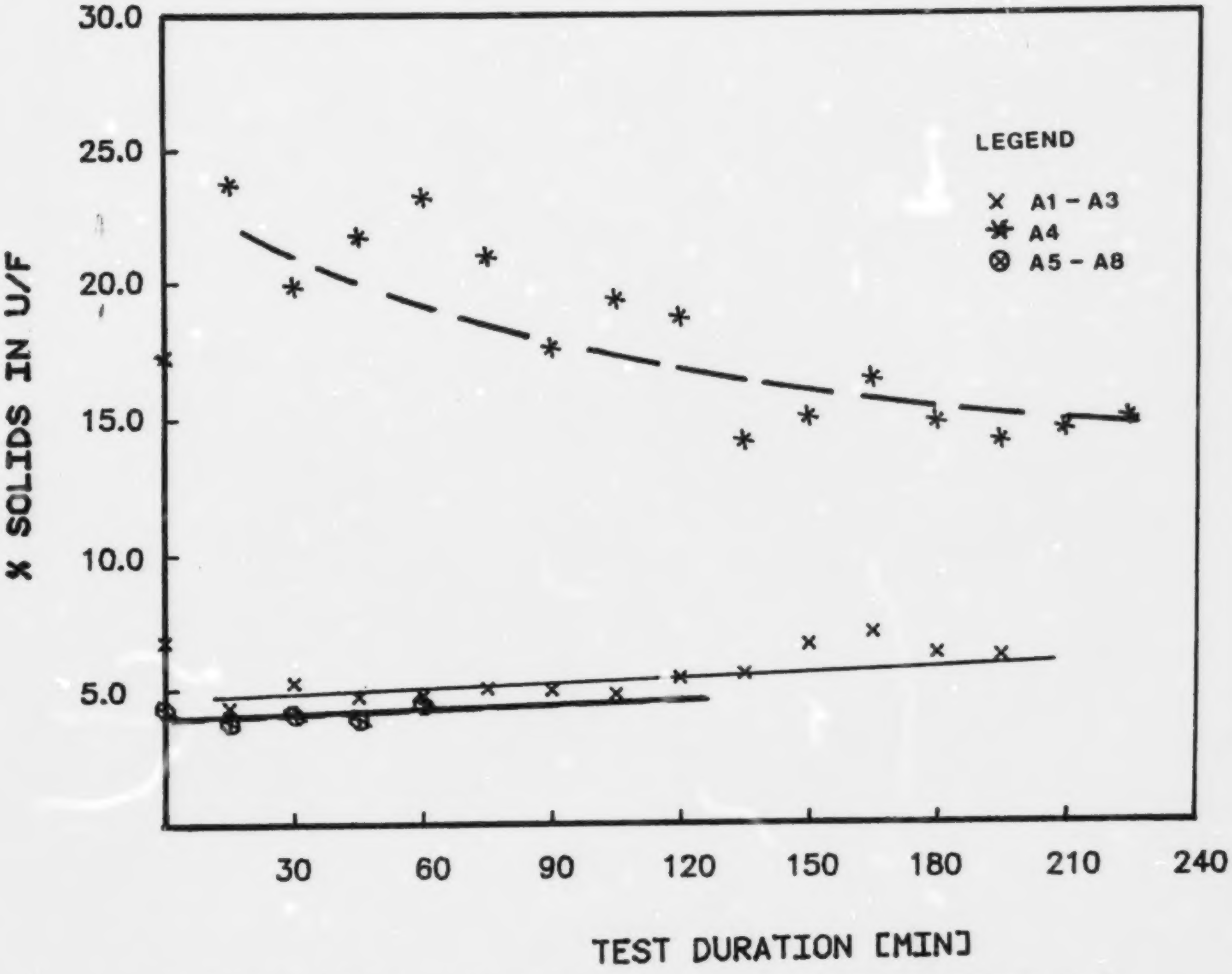


FIG. 26 MOBILE PLANT THICKENER PERFORMANCE- THICKENING DATA (TEST-A OBED) (APPENDIX-C)

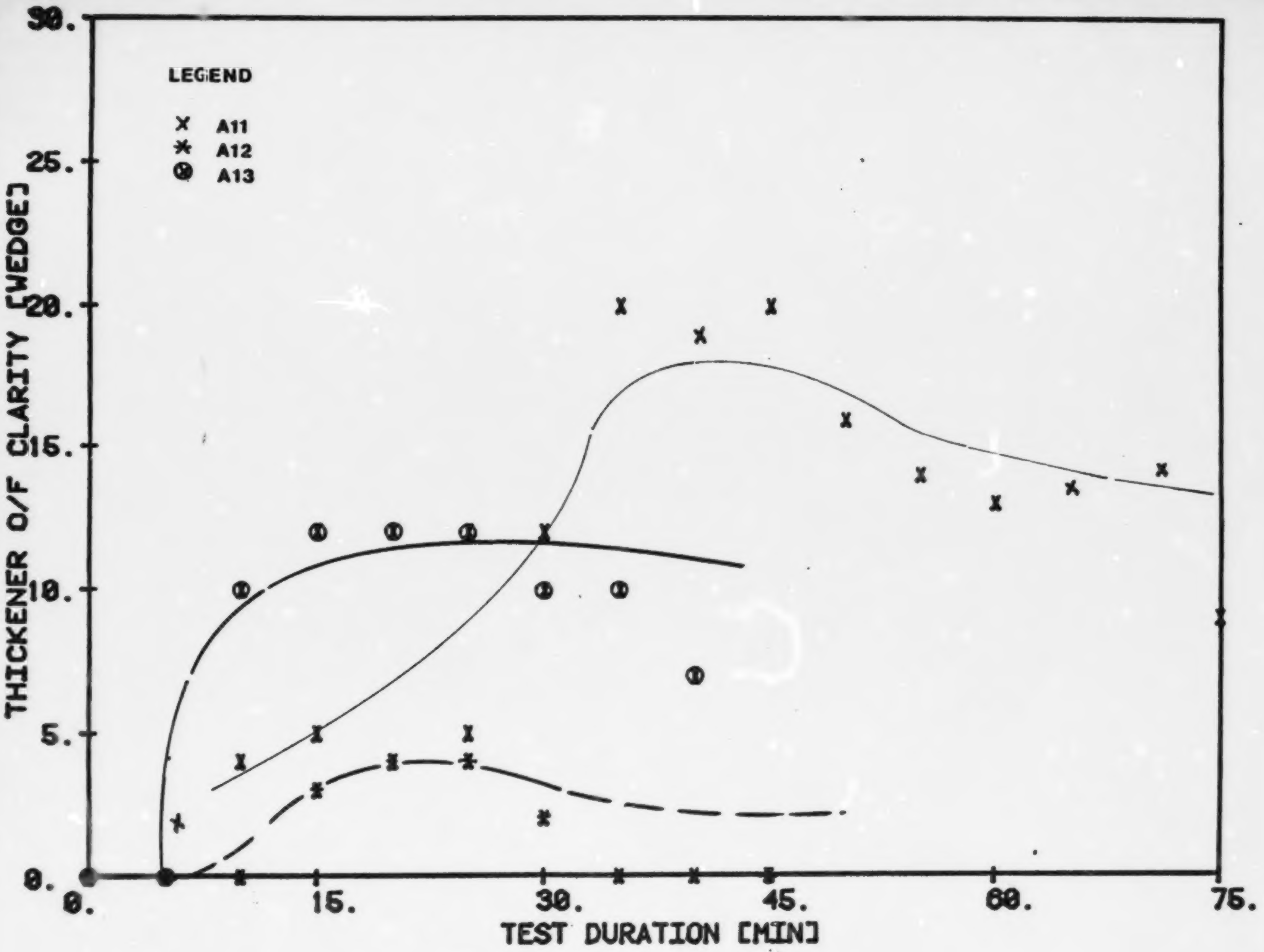


FIG. 27 MOBILE PLANT THICKENER PERFORMANCE - CLARIFICATION DATA (TEST-A OBED).
(APPENDIX - C)

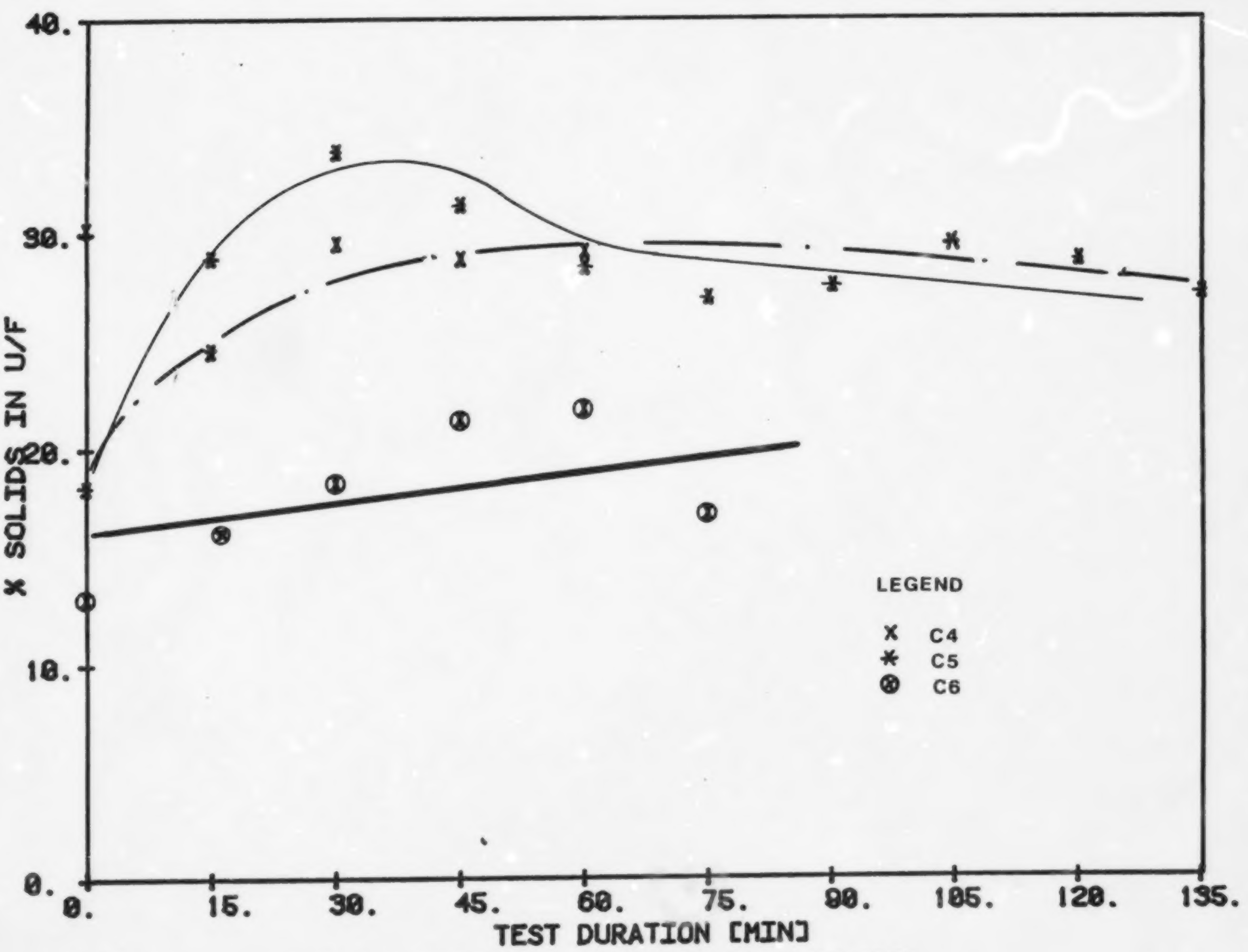


FIG. 22 MOBILE PLANT THICKENER PERFORMANCE - THICKENING DATA (TEST-C OBED).
(APPENDIX - C)

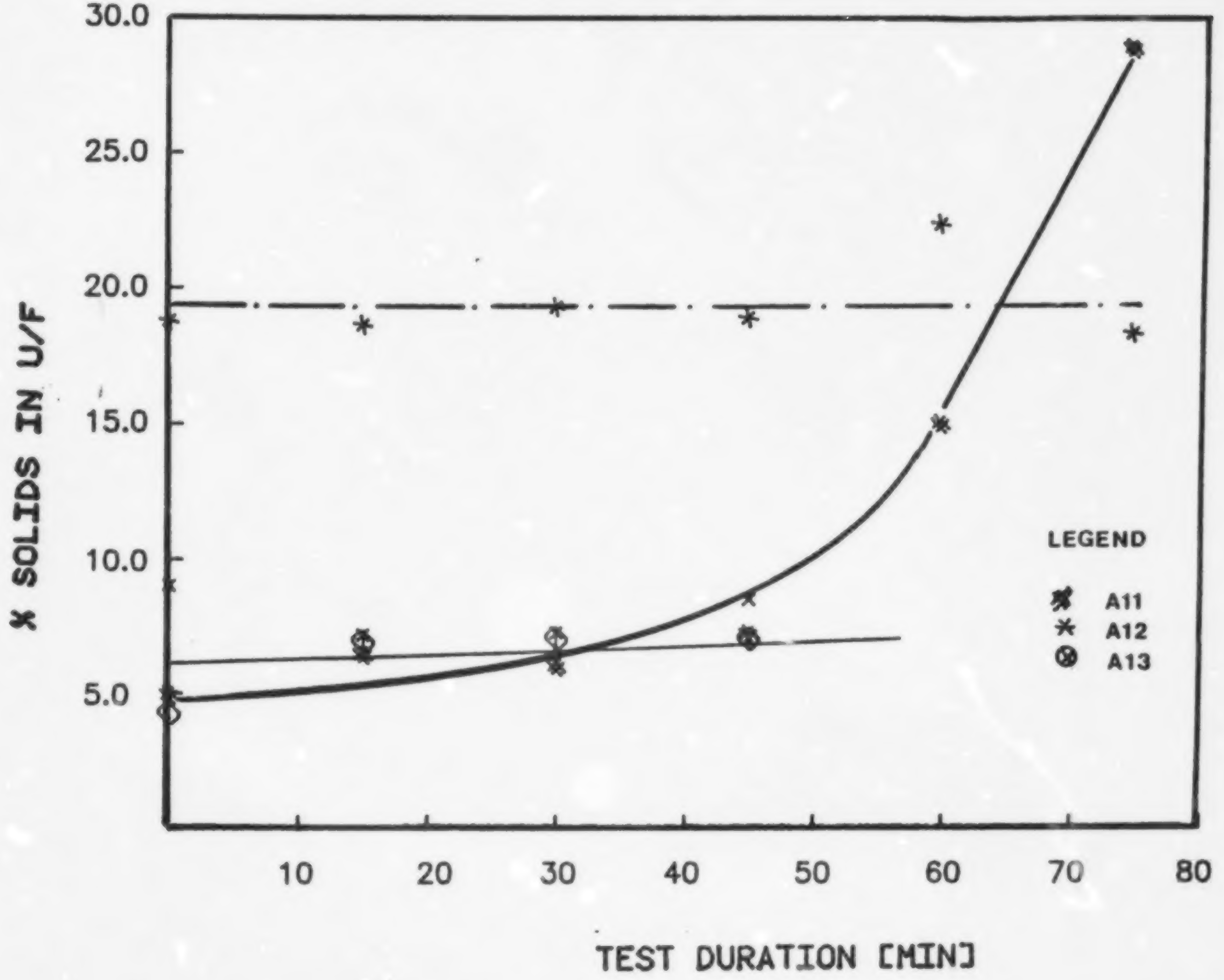


FIG. 28 MOBILE PLANT THICKENER PERFORMANCE- THICKENING DATA (TEST-A OBED)
(APPENDIX- C)

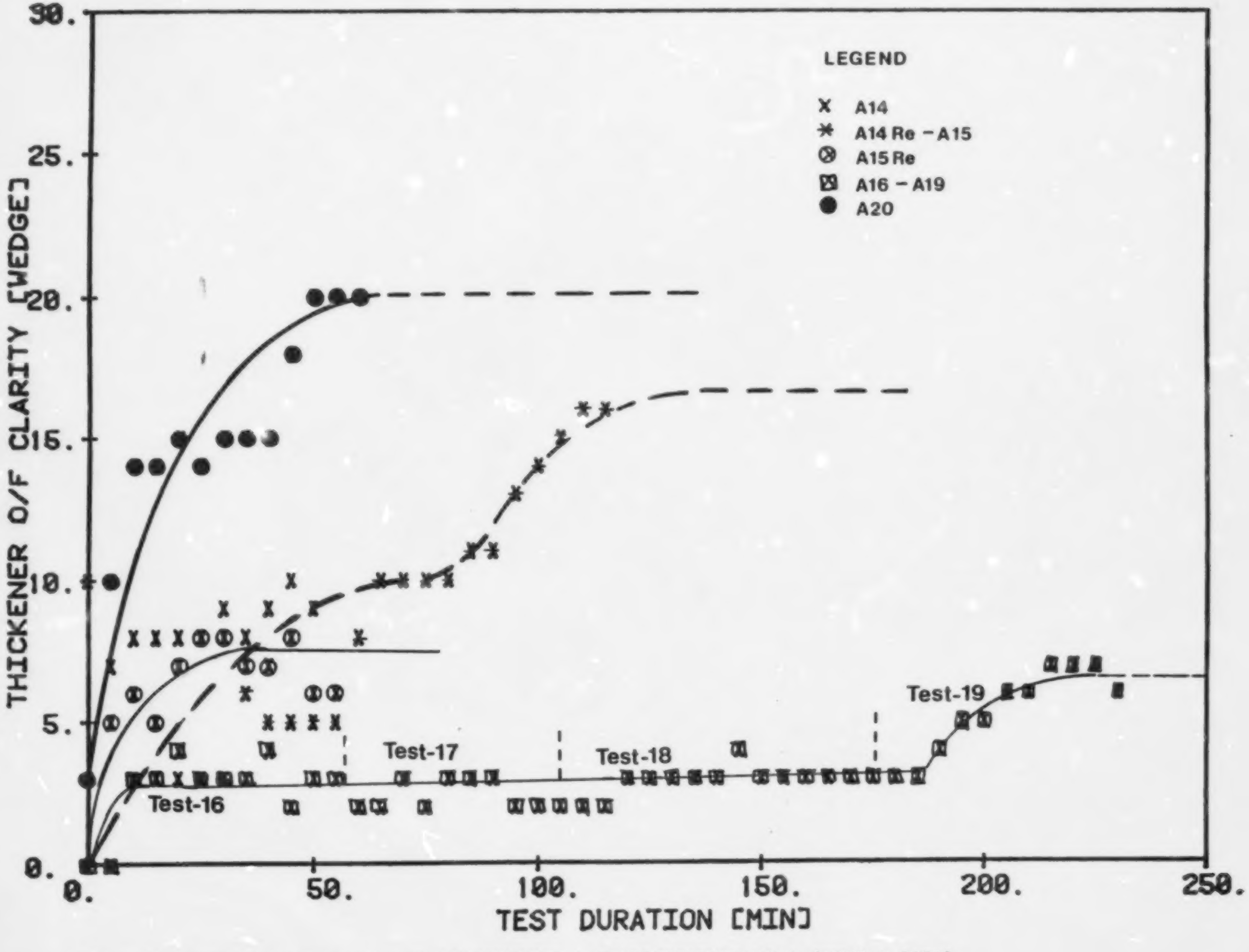


FIG. 29 MOBILE PLANT THICKENER PERFORMANCE - CLARIFICATION DATA (TEST-A OBED).
(APPENDIX - C)

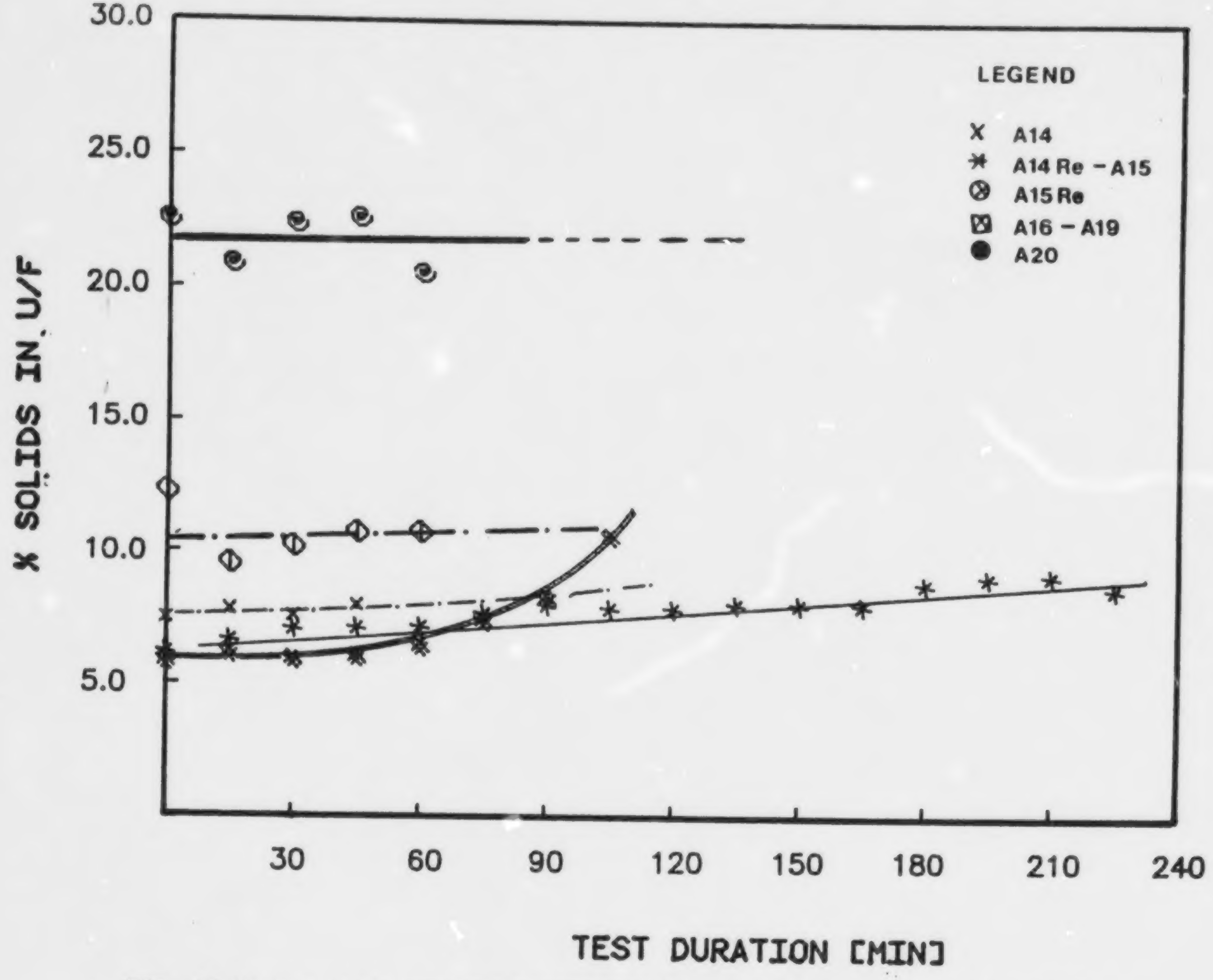


FIG. 30 MOBILE PLANT THICKENER PERFORMANCE- THICKENING DATA (TEST-A OBED) (APPENDIX-C)

APPENDIX "D"

[ANALYSIS OF THE WASHERY THICKENERS SAMPLES - MONITORING]

Analysis of the high ash thickener samples - Monitoring

Date and Time Sample Collected	% SOLIDS			ASH CONTENT (%)			SIZE ANALYSIS [FEED] (μm)						
	Feed	U/F	O/F (PPM)	Feed	U/F	O/F	+600	600x250	250x150	150x105	105x75	75x45	- 45
June 9 - 1130	3.31	11.56	9.05 (547)	67.42	65.29	NES	0.03	0	0.13	1.34	1.70	2.55	94.25
June 9 - 1630	4.57	17.17	0.08 (815)	66.37	67.30	NES	0.01	0.06	0.30	3.36	4.94	3.07	88.26
June 10 - 0700	4.11	10.29	0.07 (695)	71.38	67.35	NES	0.02	0.28	3.14	11.68	10.77	13.71	60.40
June 10 - 1800	2.99	11.88	0.06 (598)	69.46	68.72	NES	0	0.12	3.12	3.45	8.72	9.02	75.57
June 16 - 1740	3.75	17.43	Clear	72.44	48.53	NES	0	0	3.20	4.14	9.50	11.37	71.79
June 17 - 0100	4.33	22.82	0.10 (1025)	70.44	68.53	72.63	0.10	1.42	3.11	2.63	3.95	9.45	79.34
June 17 - 1515	5.17	29.10	Clear	65.00	70.18	NES	0.12	1.03	1.95	2.50	4.33	8.37	81.70
June 18 - 0100	4.65	27.32	Clear	73.86	66.05	NES	0	0.95	1.27	3.03	2.95	10.42	81.38
June 18 -1345	3.72	18.65	Clear	72.46	73.37	NES	0	0	1.65	4.12	7.11	11.32	75.80
June 19 - 0200	4.40	21.32	----	68.15	69.42	NES	0.27	1.30	2.72	3.77	6.55	10.11	75.28
June 19 - 1615	4.12	22.45	0.09	66.29	67.34	NES	0.13	0.85	1.83	3.15	5.13	7.76	81.15
June 24 - 1735	3.43	19.25	Clear	69.64	68.58	NES	0	0.23	2.14	4.29	5.05	8.69	79.60
June 25 - 0530	5.19	31.92	Clear	68.68	68.94	NES	0.19	0.87	1.97	3.15	4.67	8.56	80.59
June 25 - 1420	2.97	14.84	Clear	70.76	70.86	NES	0.11	0	2.15	4.10	4.23	9.27	80.14

Analysis of the low ash thickener samples - Monitoring

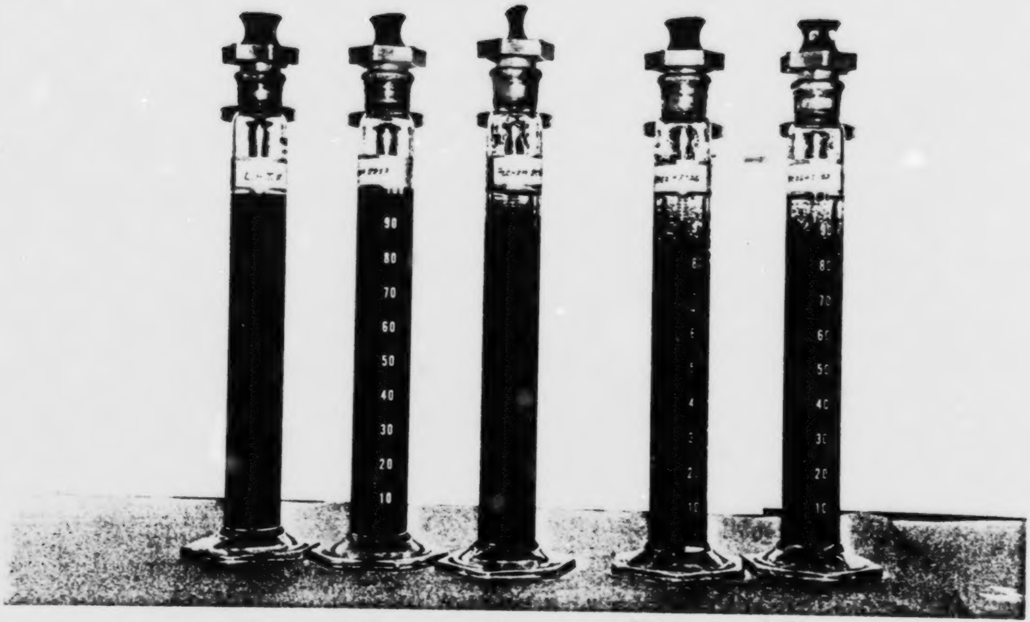
Date and Time Sample Collected	% SOLIDS			ASH CONTENT (%)			SIZE ANALYSIS [FEED] (μm)						
	Feed	U/F	O/F (PPM)	Feed	U/F	O/F	+600	600x250	250x150	150x105	105x75	75x45	- 45
June 9 - 1130	5.47	18.76	0.07 (686)	68.12	57.32	NES	0	0.92	3.53	4.25	7.85	7.23	76.22
June 9 - 1630	4.65	34.86	0.07 (709)	67.53	55.35	NES	0	1.33	2.92	3.15	3.53	9.57	79.50
June 10 - 0700	4.54	39.94	0.07 (710)	56.28	62.03	NES	8.05	10.28	5.08	5.58	8.14	5.84	56.83
June 10 - 1800	5.61	16.93	0.10 (1052)	53.77	49.29	NES	1.27	0.17	3.20	3.13	9.25	10.12	72.86
June 17 - 0100	4.05	32.72	-----	58.59	61.32	NES	0	1.32	4.25	3.67	3.40	9.57	77.79
June 18 - 0200	3.27	36.70	-----	58.44	47.30	NES	0.27	2.35	3.67	5.63	6.44	10.63	71.01
June 18 - 1610	3.49	29.10	Clear	53.10	50.11	NES	0.22	1.69	3.49	4.77	3.67	9.27	76.89
June 19 - 0200	5.10	17.25	-----	55.25	43.35	NES	0	1.14	2.36	3.69	2.75	8.10	81.90
June 19 - 1610	4.27	19.03	0.03 (305)	65.45	68.18	NES	1.37	2.07	4.70	4.86	3.20	9.29	74.51
June 24 - 1745	3.95	27.15	Clear	47.50	41.79	NES	0	1.39	3.27	4.65	4.53	10.42	75.74
June 25 - 0530	5.05	39.26	-----	51.70	46.29	NES	0	1.47	2.44	6.23	4.42	9.37	76.07
June 25 - 1420	5.32	34.43	Clear	49.28	56.14	NES	0.35	2.19	3.73	5.54	4.57	9.67	73.95

Analysis of the high ash thickener samples - Monitoring

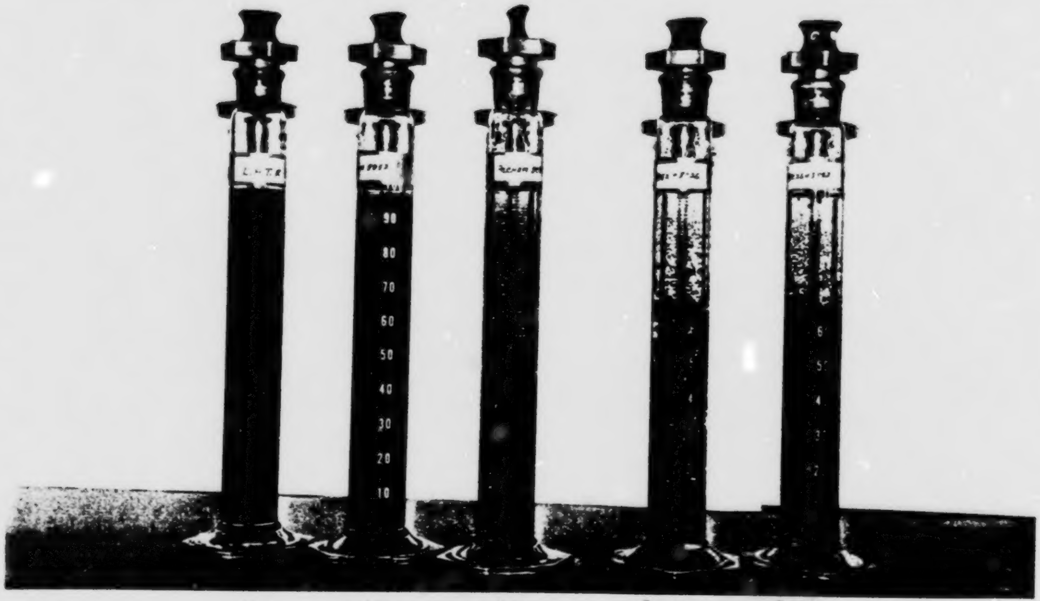
Date and Time Sample Collected	% SOLIDS			ASH CONTENT (%)			SIZE ANALYSIS [FEED] (μm)						
	Feed	U/F	O/F (PPM)	Feed	U/F	O/F	+600	600x250	250x150	150x105	105x75	75x45	- 45
Sept 21 - 1330	4.22	18.52	0.06 (572)	57.10	59.36	NES	0.22	0.93	2.72	4.73	4.85	8.93	77.62
Sept 22 - 1230	3.87	19.31	0.04 (430)	67.23	59.52	NES	0.13	1.22	3.49	3.72	9.22	8.70	73.52
Sept 23 - 1115	3.95	17.92	Clear	69.27	68.11	NES	0	1.31	1.92	2.93	5.63	9.27	78.94
Sept 24 - 1400	4.19	20.03	Clear	70.01	67.32	NES	0	0.87	1.80	3.52	4.27	10.11	79.43
Oct 6 - 1600	2.78	19.36	Clear	68.12	60.52	NES	0.12	1.39	2.57	4.80	6.35	9.61	75.16
Oct 7 - 1135	4.57	23.19	Clear	59.72	55.32	NES	0	1.97	4.25	3.53	4.59	8.34	77.32
Oct 8 - 1245	5.86	27.55	Clear	63.47	59.29	NES	0.17	1.33	3.02	5.47	5.73	8.71	75.57
Oct 22 - 1550	4.36	22.38	Clear	66.38	60.44	NES	0.12	1.37	1.86	4.03	3.69	8.82	80.11
Oct 23 - 1230	4.86	21.70	Clear	69.72	65.11	NES	0	0.67	2.12	2.96	5.67	9.76	78.82
Oct 24 - 1430	5.11	19.62	Clear	71.02	68.60	NES	0	1.32	3.57	3.02	7.11	7.25	77/73
Nov 23 - 1030	3.07	17.66	0.08 (773)	66.54	63.29	NES	0.11	1.42	2.93	4.32	6.92	8.40	75.90
Nov 24 - 1300	3.42	15.28	Clear	70.19	69.42	NES	0.17	0.83	1.92	3.70	5.52	9.32	78.54
Nov 25 - 1530	5.11	21.37	Clear	68.45	59.29	NES	0	0.94	2.02	3.27	4.43	10.34	79.00
Dec 9 - 1400	3.89	17.15	Clear	59.03	61.25	NES	0.11	0.75	1.97	4.72	5.83	9.92	76.70
Dec 10 - 1245	5.53	20.52	Clear	62.77	60.42	NES	0	1.31	2.72	3.62	6.47	12.32	73.56
Dec 11 - 1100	4.78	21.03	Clear	61.09	58.22	NES	0	0.66	2.08	3.05	7.22	11.51	75.48

APPENDIX "E"

(Photographs of the bench scale settling rate tests)

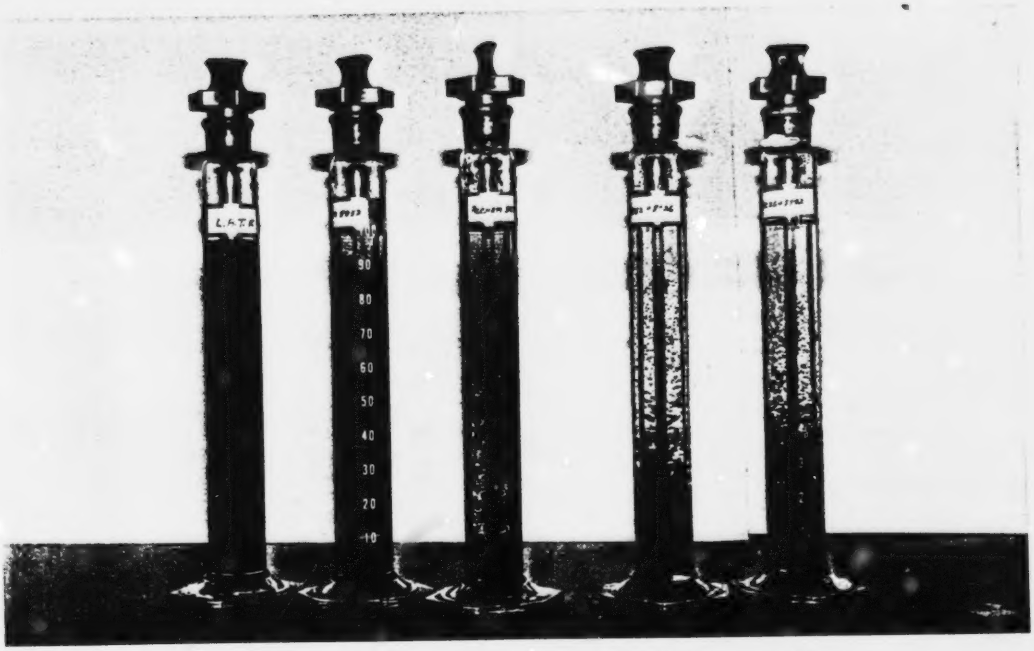


1 - (a) T = 10 sec.

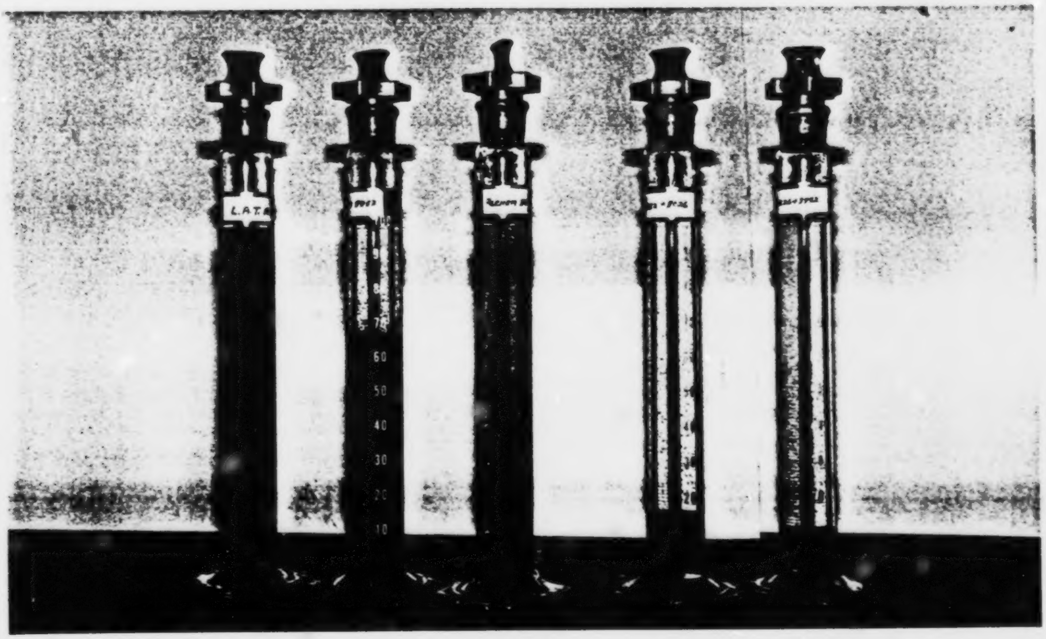


1 - (b) T = 20 sec.

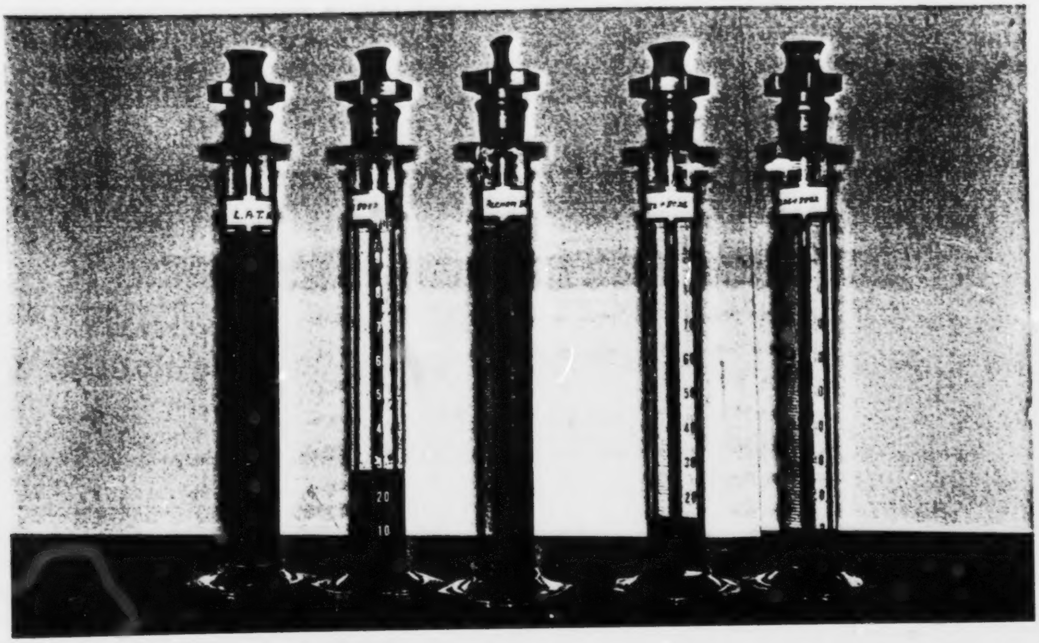
Figure 1 - Comparison of the performance of the Alchem flocculants [8852 and 8C26] for the low ash thickener feed.
Settling Time (Sec.) - (a) 10, (b) 20, (c) 30, (d) 40, (e) 50, (f) 60.



1 - (c) T = 30 sec.

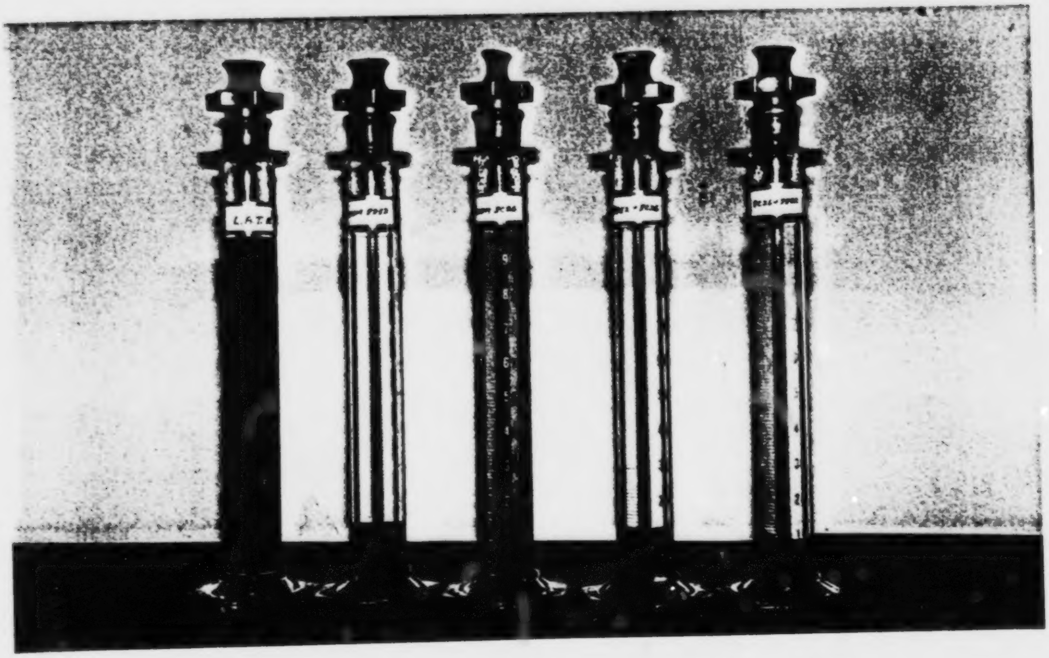


1 - (d) T = 40 sec.



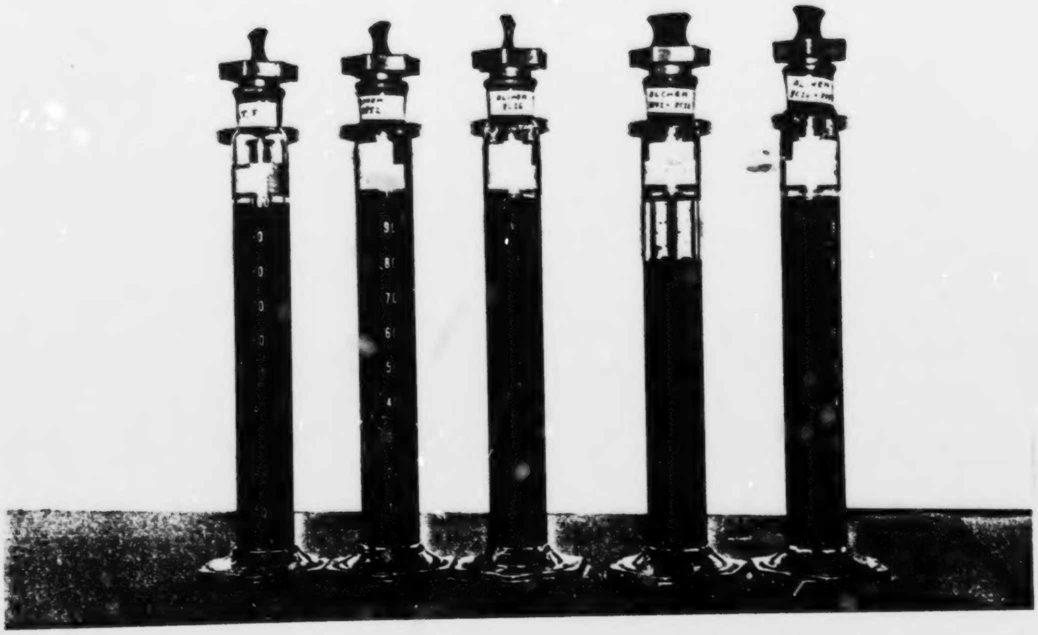
NO FLOC. CAT AN [CAT + AN] [AN + CAT]

1 - (e) T = 50 sec.

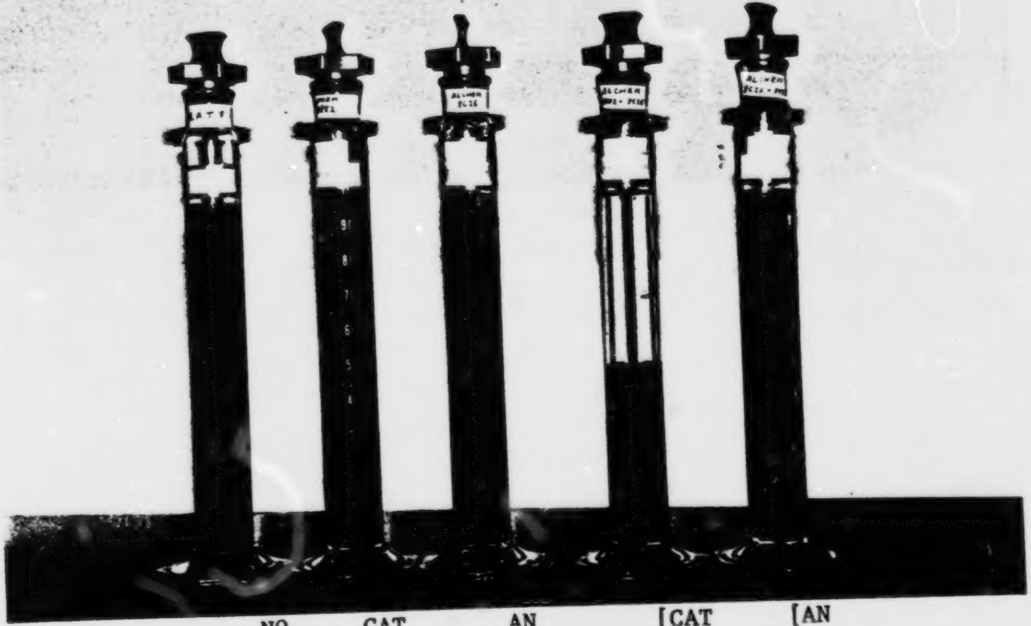


NO FLOC. CAT AN [CAT + AN] [AN + CAT]

1 - (f) T = 60 sec.

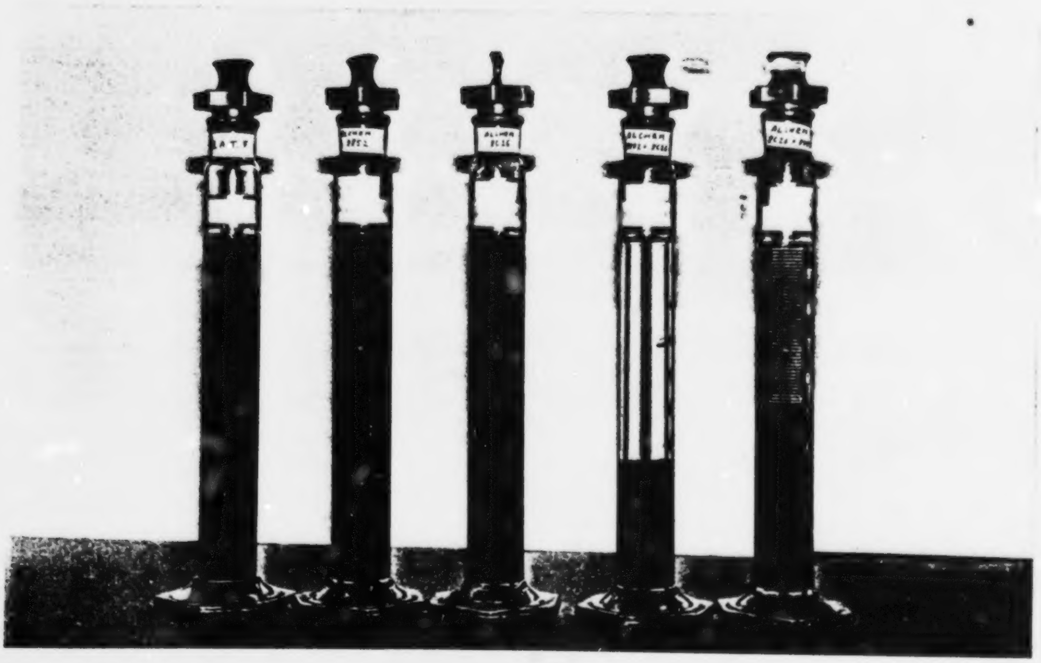


2 - (a) T = 10 sec.

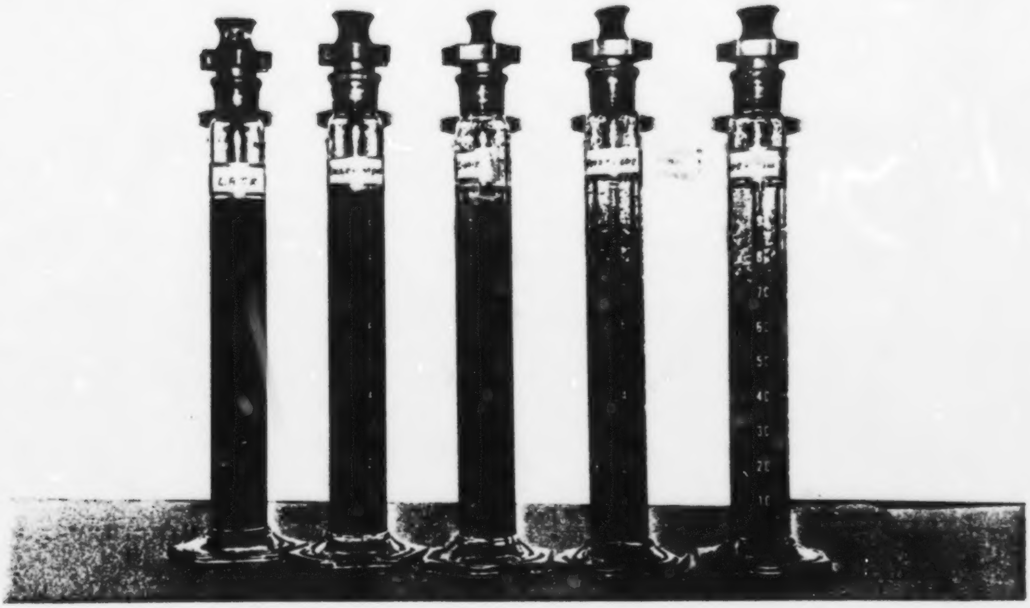


2 - (b) T = 20 sec.

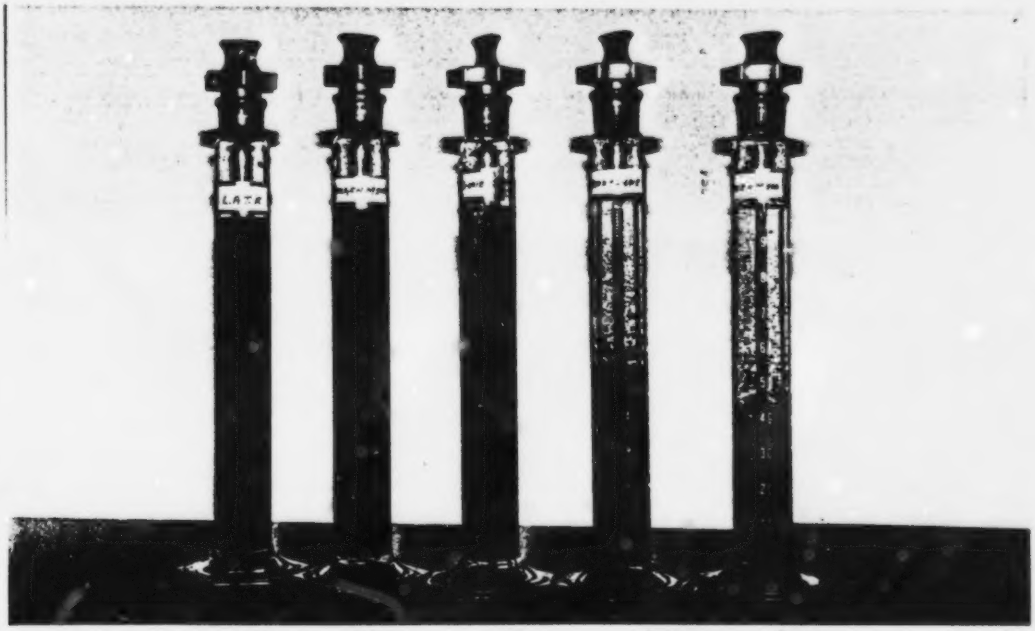
Figure 2 - Comparison of the performance of the Alchem flocculents [8852 and 8C26] for the high ash thickener feed. Settling time (Sec.) - (a) 10, (b) 20, (c) 30.



```
                  NO    CAT      AN      [CAT    [AN
                 FLOC.                     +       +
2 - (c)   T = 30 sec.                     AN]    CAT]
```

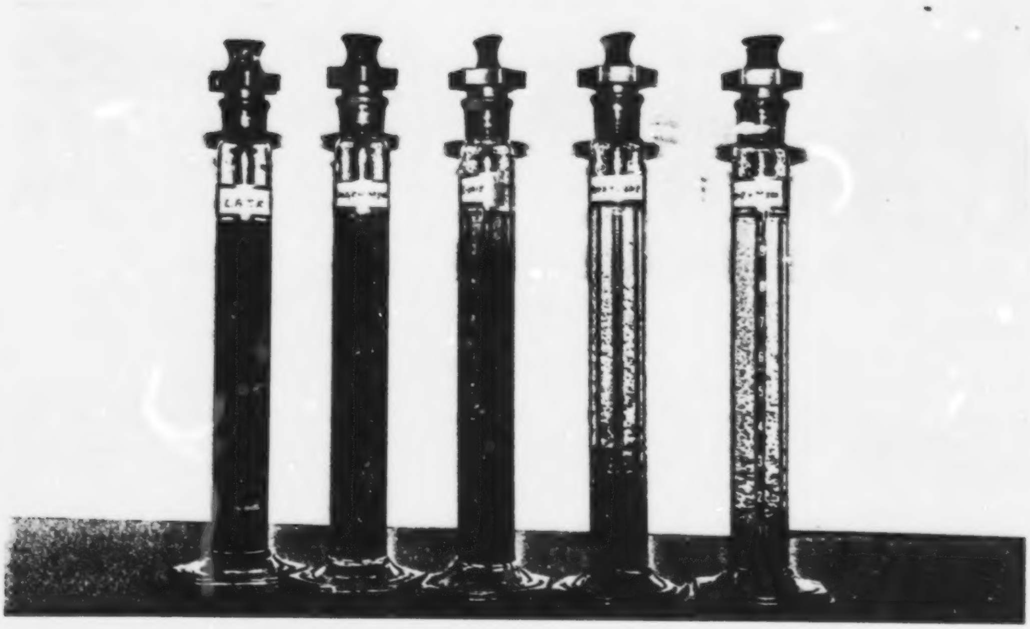


3 - (a) T = 10 sec.



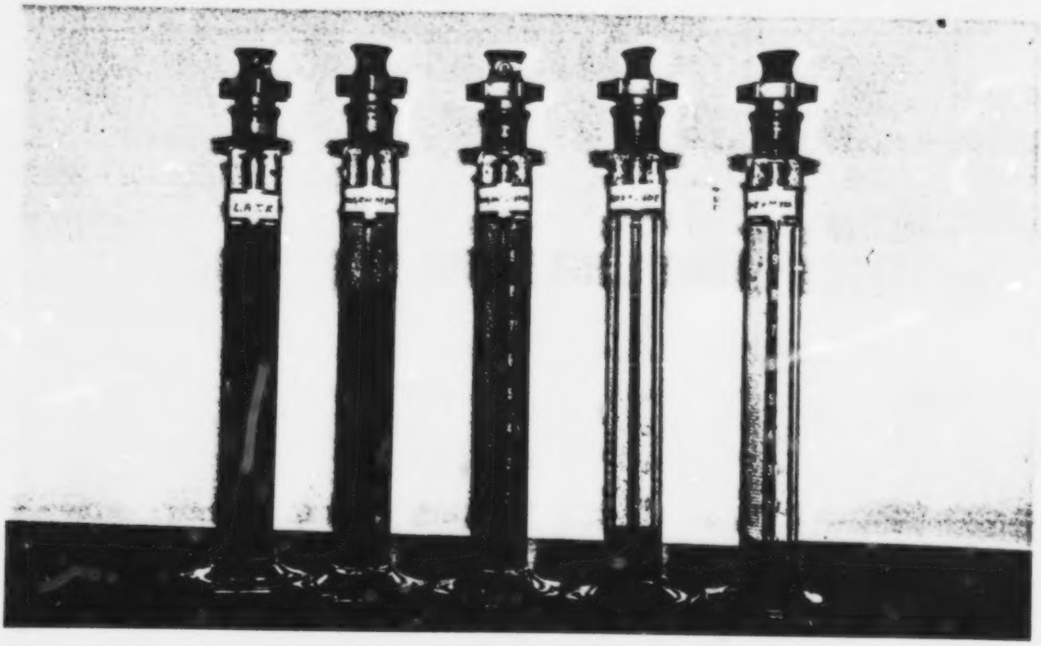
3 - (b) T = 20 sec.

Figure 3 - Comparison of the performance of the Calgon flocculants [M502 and L-691E] for the low ash thickener feed. Settling time (Sec.) - (a) 10, (b) 20, (c) 30, (d) 40, (e) 50.



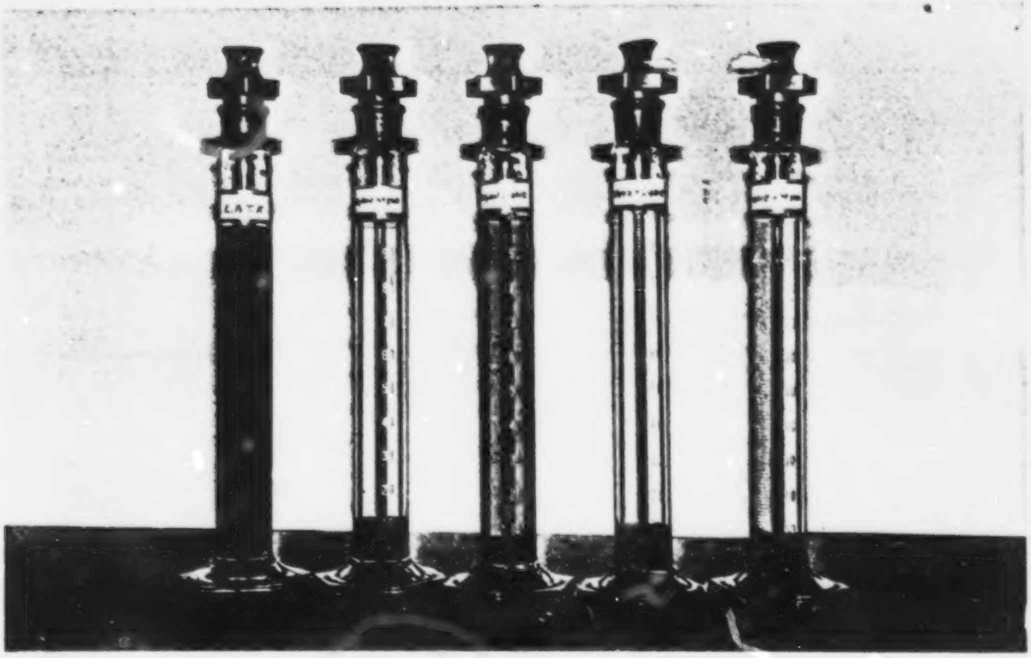
NO FLOC. CAT AN [CAT + AN] [AN + CAT]

3 - (c) T = 30 sec.



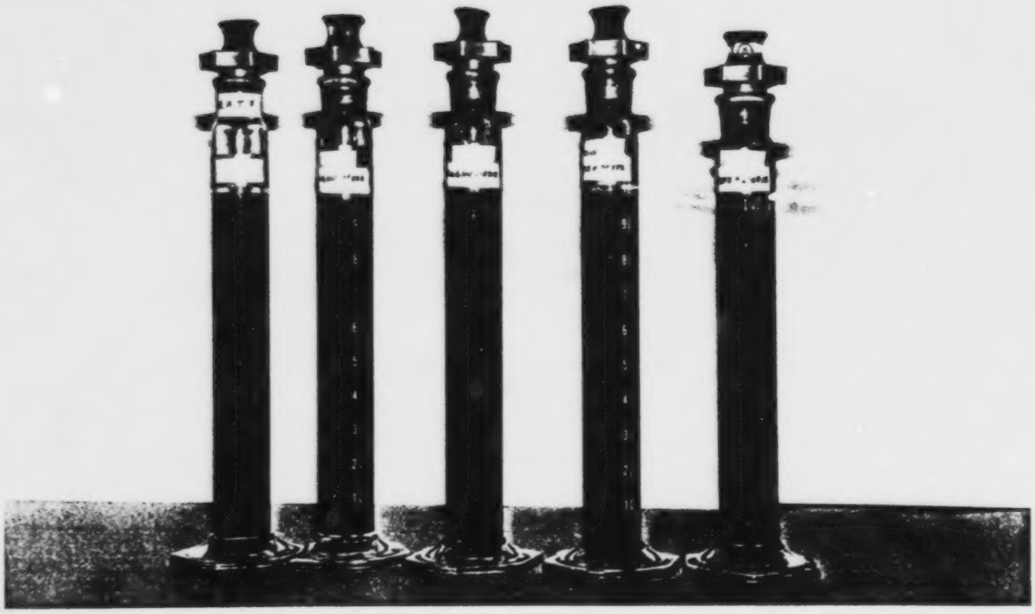
NO FLOC. CAT AN [CAT + AN] [AN + CAT]

3 - (d) T = 40 sec.



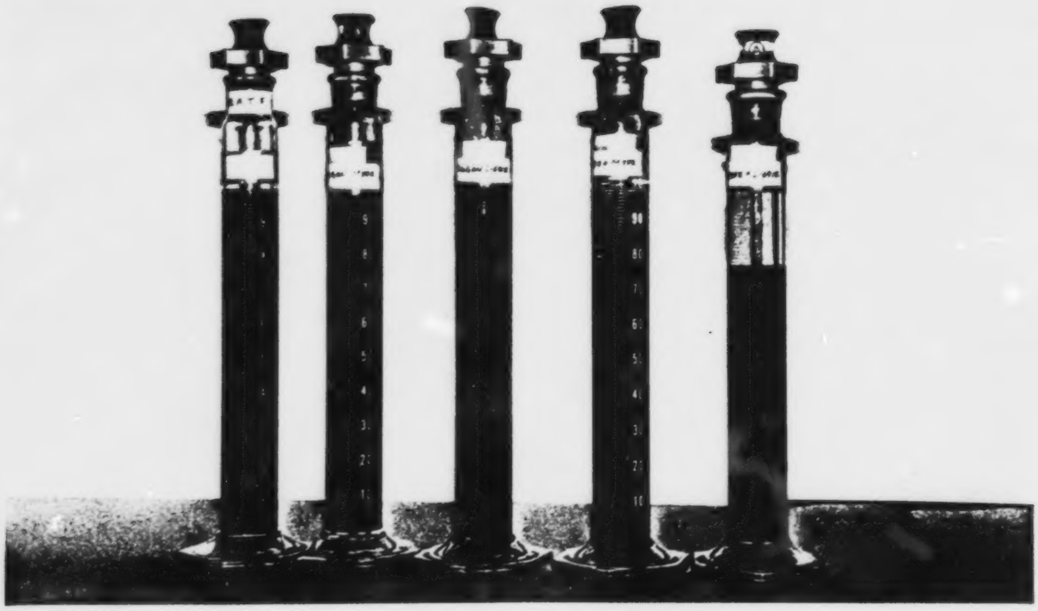
NO FLOC.	CAT	AN	[CAT + AN]	[AN + CAT]

3 - (e) T = 50 sec.



NO FLOC. CAT AN [CAT + AN] [AN + CAT]

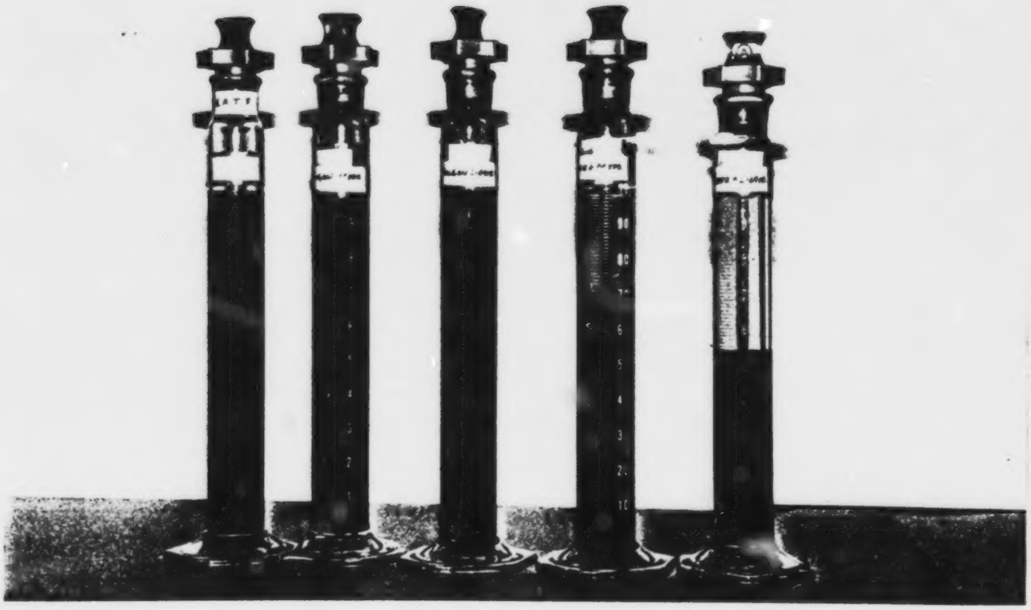
4 - (a) T = 10 sec.



NO FLOC. CAT AN [CAT + AN] [AN + CAT]

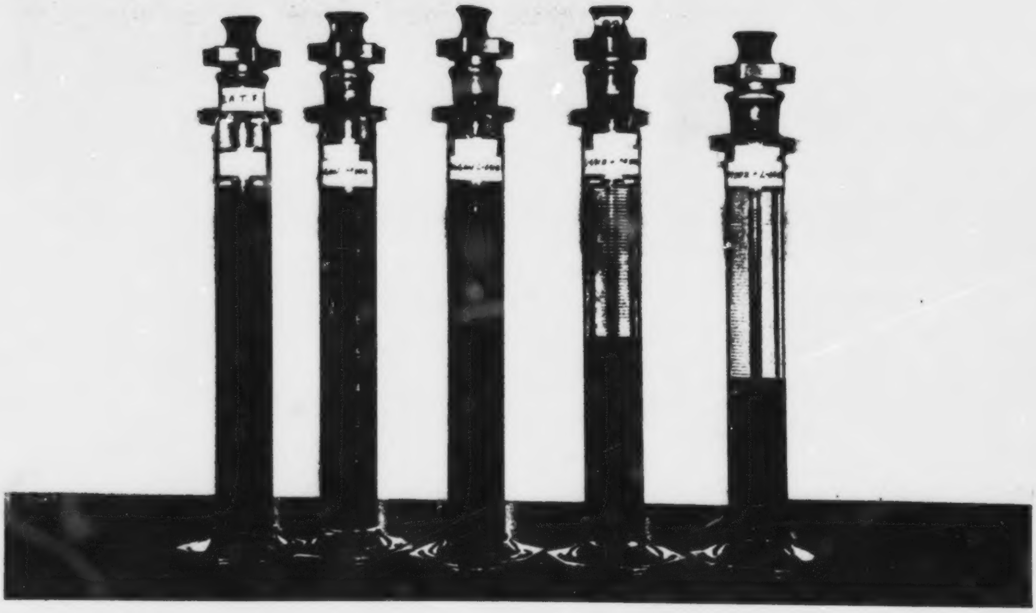
4 - (b) T = 20 sec.

Figure 4 - Comparison of the performance of the Calgon flocculants [M502 and L-691E] for the high ash thickener feed. Settling time (Sec.) - (a) 10, (b) 20, (c) 30, (d) 40.



NO FLOC. CAT AN [CAT + AN] [AN + CAT]

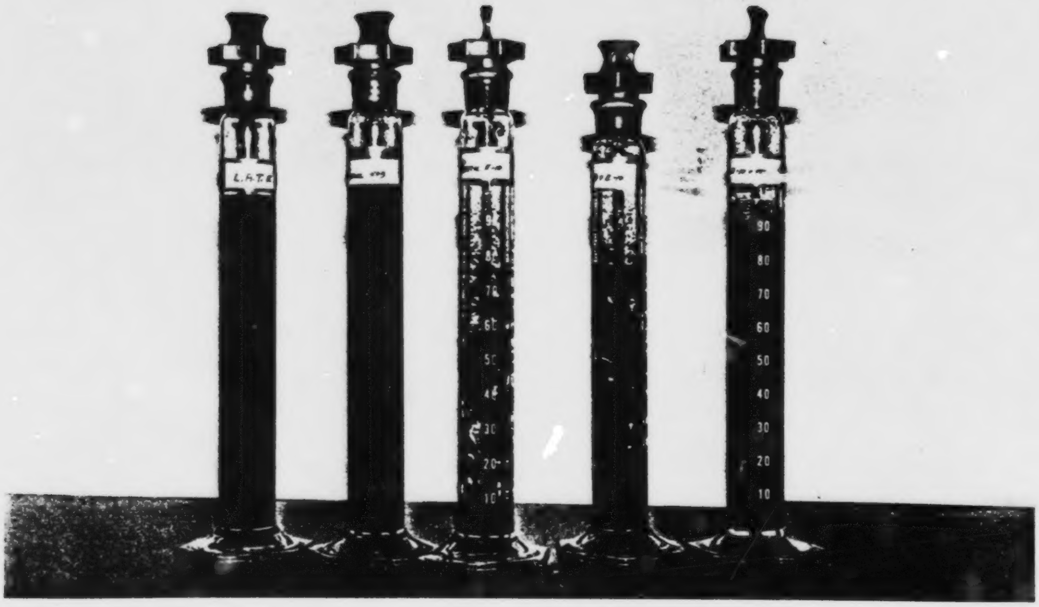
4 - (c) T = 30 sec.



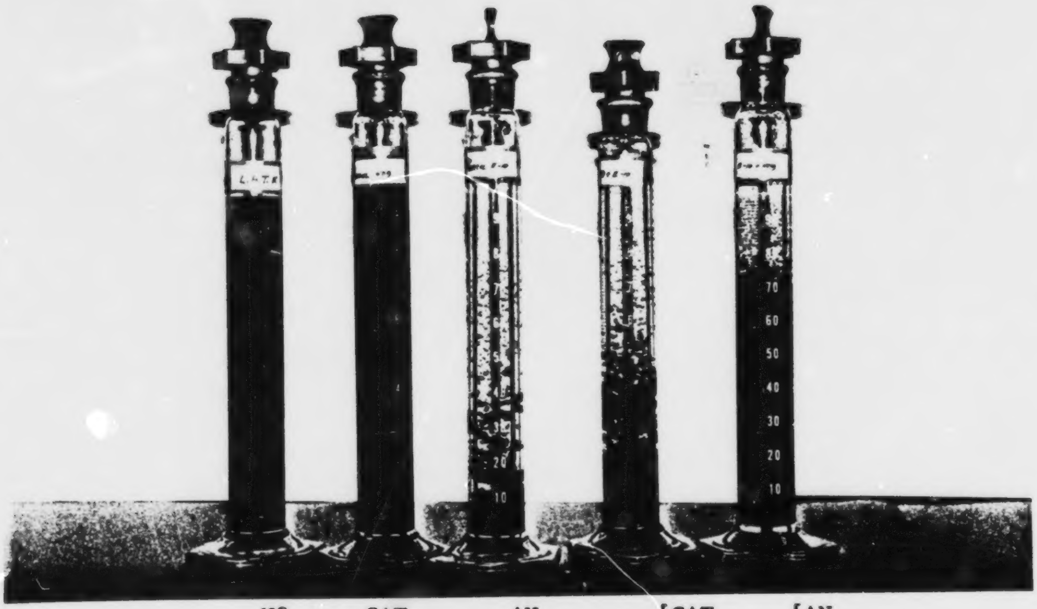
NO FLOC. CAT AN [CAT + AN] [AN + CAT]

4 - (d) T = 40 sec.

1732

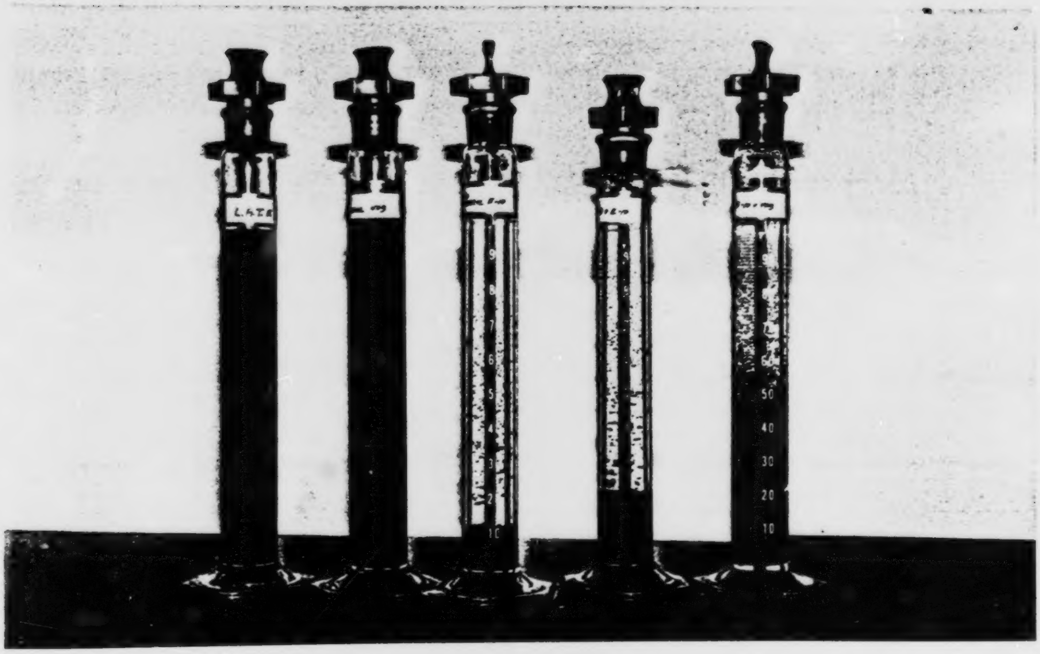


5 - (a) T = 10 sec.



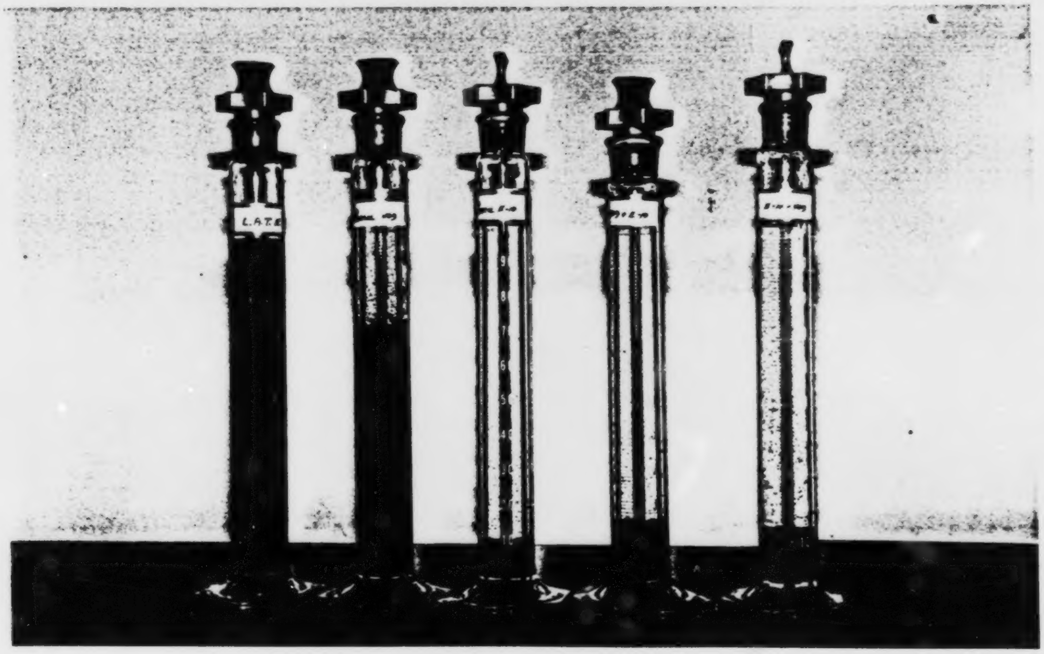
5 - (b) T = 20 sec.

Figure 5 - Comparison of the performance of the Percol flocculants [E10 and 403] for the low ash thickener feed. Settling time (Sec.) - (a) 10, (b) 20, (c) 30, (d) 40, (e) 50, (f) 60.



NO FLOC. CAT AN [CAT + AN] [AN + CAT]

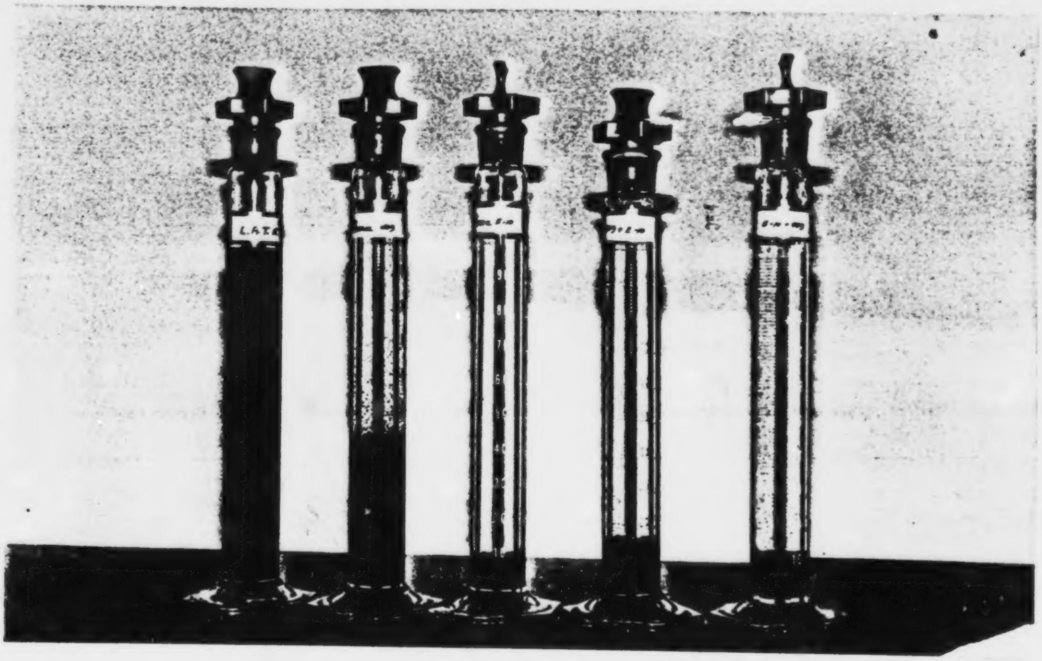
5 - (c) T = 30 sec.



NO FLOC. CAT AN [CAT + AN] [AN + CAT]

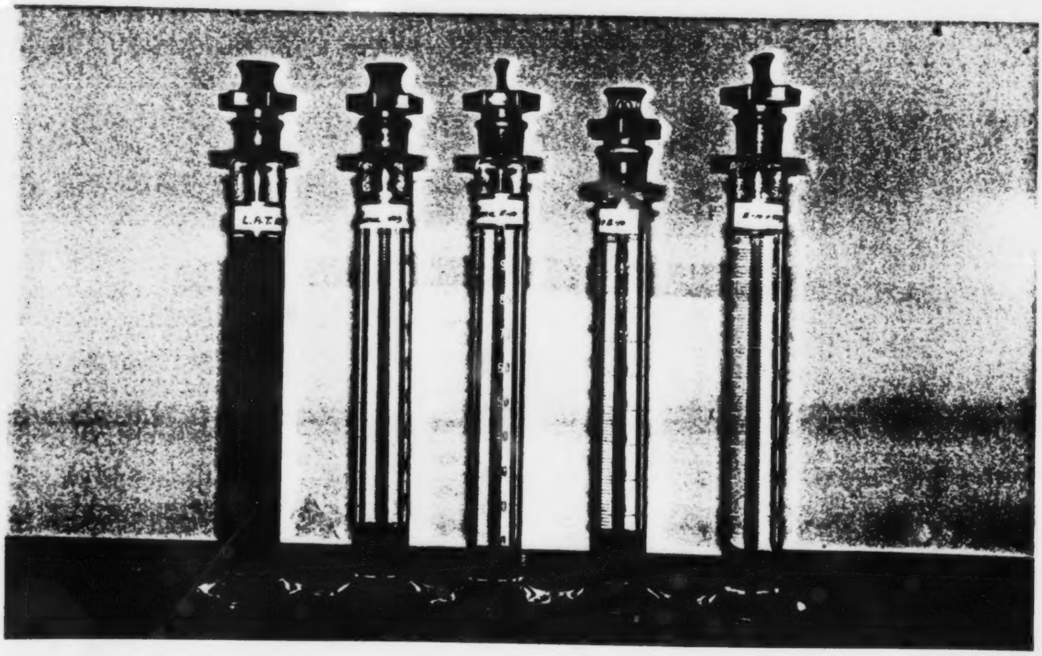
5 - (d) T = 40 sec.

1732



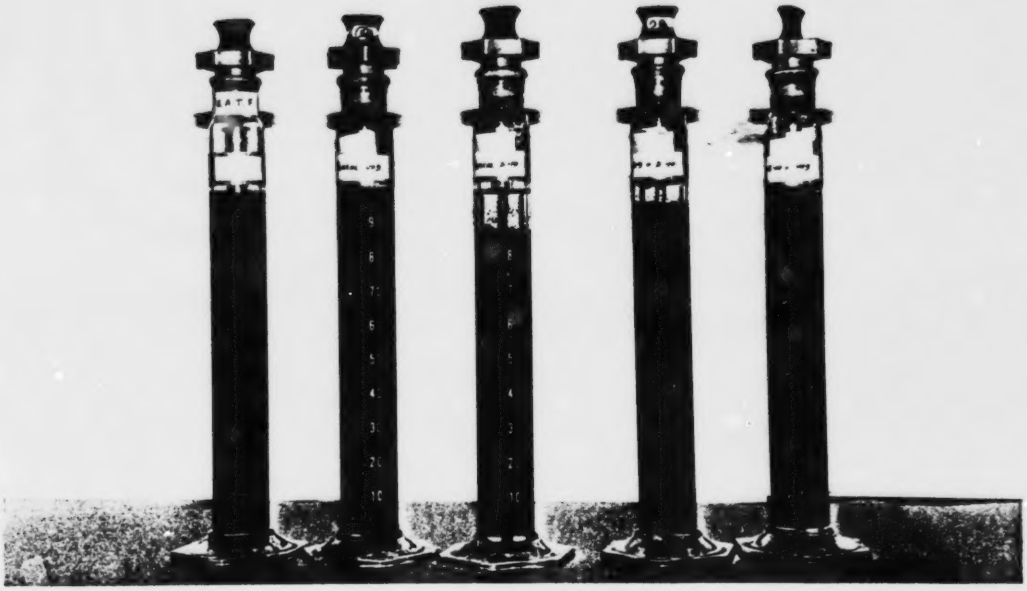
NO FLOC. CAT AN [CAT + AN] [AN + CAT]

5 - (e) T = 50 sec.

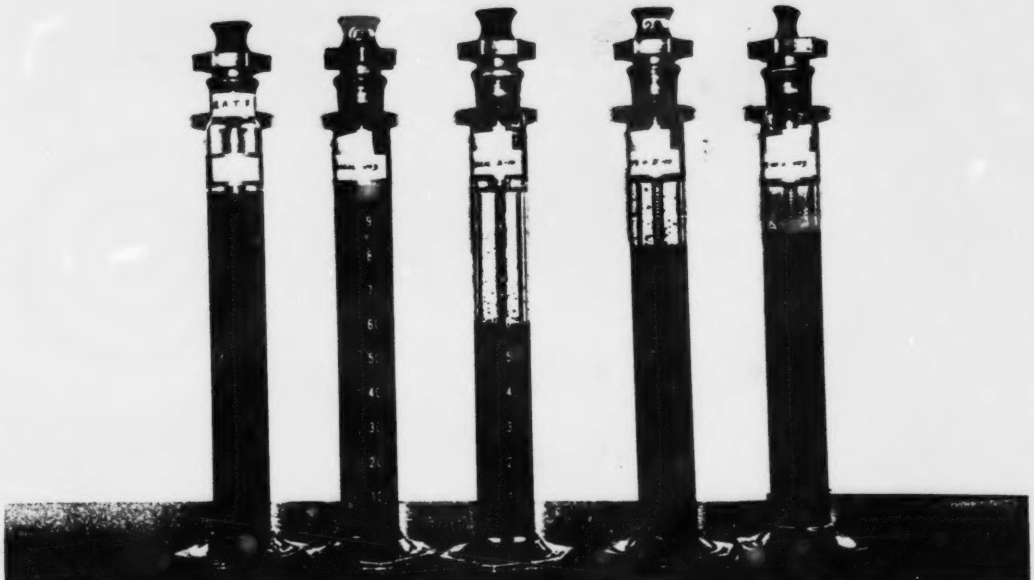


NO FLOC. CAT AN [CAT AN] [AN CAT]

5 - (f) T = 60 sec.

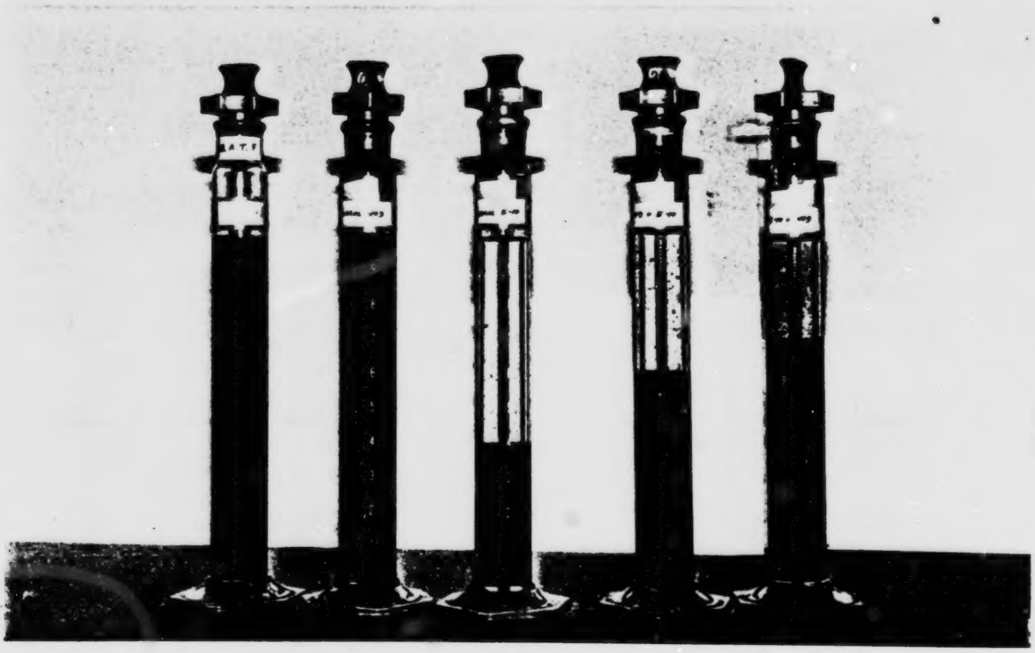


6 - (a) T = 10 sec.



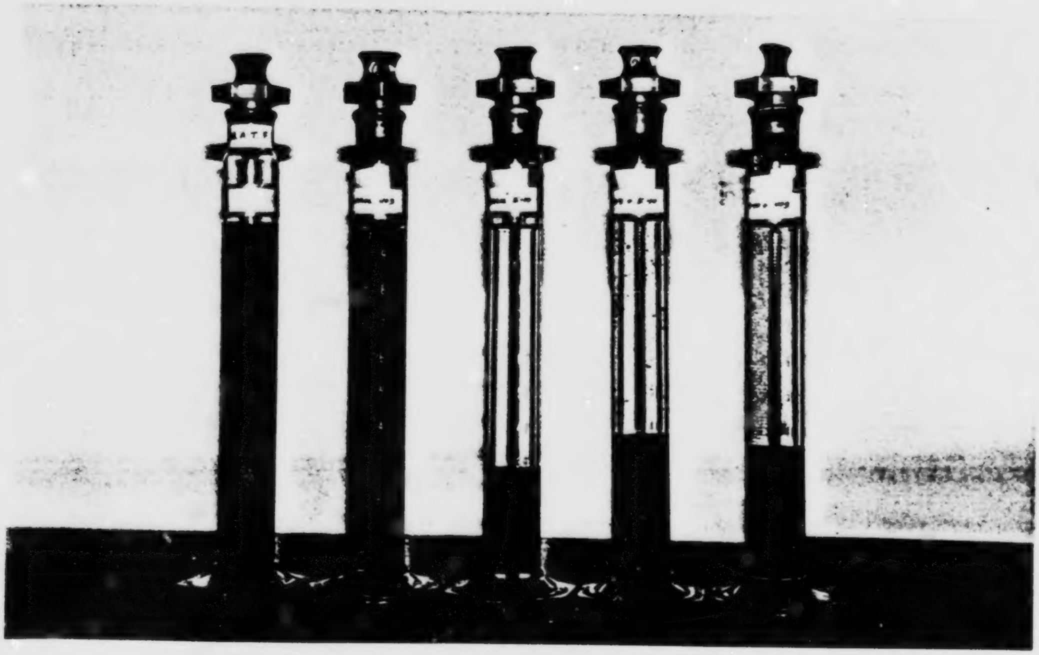
6 - (b) T = 20 sec.

Figure 6 - Comparison of the performance of the Percol flocculants [E10 and 403] for the high ash thickener feed. Settling time (Sec.) - (a) 10, (b) 20, (c) 30, (d) 40.



NO FLOC. CAT AN [CAT + AN] [AN + CAT]

6 - (c) T = 30 sec.



NO FLOC. CAT AN [CAT + AN] [AN + CAT]

6 - (d) T = 40 sec.

APPENDIX "F"

[THICKENER PERFORMANCE DATA]

15

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: June 26/85 **TEST I.D.** P1

FLOCCULANTS: [ALLIED COLLOIDS]

-CATIONIC ______

-ANIONIC Percol E10

ORDER OF FLOCCULANT ADDITION Only Anionic was added

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1120	0	0	2/2	Problems with thickener underflow pump [pb]- mobile plant was down for about 3 hours to fix the pump. Poor flocculation. No improvement in overflow clarity.
	5	0	2/7/7	
1130	10	0	7/7/6	
	15	0	7/7/8	
	20	0	6/7/7	
	25	0	7/7/7	
	30	0	9/8/8	
	35	0	8/9/9	
1200	40	0	7/8/8	
	45	0	8/8/6	Flocculant dosages increased from 116.2 to 232.4 g/t
	50	0	7/7/7	
	55	0	7/7/6	
	60	0	7/8/7	
	65	0	7/7/7	No improvement in the overflow and the underflow does not look good (about 10%)
1230	70	0	6/7/7	
	75	0	8/7/7	
	80	0	7/8/7	

10

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: June 26 **TEST I.D.** P1 (Page-2)

FLOCCULANTS:

-CATIONIC ____________

-ANIONIC ____________

ORDER OF FLOCCULANT ADDITION Percol E10

TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
85	0	8/7/7	No improvement in underflow and overflow.
90	0	2/2	
95	0	9/9	Flocculant dosages increased at 90 min. from 232.4 to 464.8 g/t
1300 100	0	2/9	
105	0	9/10	
110	0	10/10	
115	0	11/11	
120	0	12/12	
125	0	11/12	
1330 130	0	12/12	
135	0	13/12	
140	0	12/12	
1345 145	0	12/12	Test discontinued at 145 minutes - NO improvement in the O/F & W/F quality
150			
155			Could not do any more tests: frequent interruption in the feed supply.
160			
165			

15

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Sept. 20/85 **TEST I.D.** P2

FLOCCULANTS: [ALLIED COLLOIDS]

-CATIONIC Percol LT31

-ANIONIC Percol E10

ORDER OF FLOCCULANT ADDITION Cation + Anion

TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1645 0	0	7/7	(1145-1600) Frequent interruption the feed supply, had to discontinue the test twice.
5	0	7/6	
10	0	7/7	
15	0	7/7	
20	3/3	7/8	O/F improving U/F does not look any better.
25	3/4	7/7	
1715 30	6/6	7/6	
35	6/6	7/7	
40	6/6	7/8	At 45 min. both flocculant dosages increased to double
45	8/7	9/10	
50	7/7	10/11	O/F bit better
55	7/7	10/12	
1745 60	7/8	12/13	
65	2/2	11/11	
70	2/2	12/12	No improvement in O/F clarity.
75	7/8	11/11	
80	7/8	12/11	

lU

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Sept. 20 **TEST I.D.** P2 (Page 2)

FLOCCULANTS:

-CATIONIC Percol LT31

-ANIONIC Percol E10

ORDER OF FLOCCULANT ADDITION CATION + ANION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	85	8/8	11/11	
1815	90	8/8	11/12	
	95	7/8	11/12	
	100	7/8	12/12	
	105	8/8	12/12	
	110			
	115			
	120			
	125			
	130			
	135			
	140			
	145			
	150			
	155			
	160			
	165			

15

THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Sept. 21/85 **TEST I.D.** P3

FLOCCULANTS: [ALLIED COLLOIDS]

-CATIONIC Percol LT31

-ANIONIC Percol E10

ORDER OF FLOCCULANT ADDITION ANION + CATION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1000	0	0	10/10	Could not conduct the testwork till 0940 due to interruption in the feed from washery.
	5	0	12/12	
	10	0	12/12	
	15	10/9/9	13/14	Good flocculation
	20	9/9/9	15/15	
	25	16/18	15/16	O/F clarity improving
1030	30	20/20	16/16	
	35	19/20	18/18	
	40	19/18	18/18	
	45	19/20	18/19	At 45 min. - Both flocculant dosages increased to double.
	50	20/20	16/16	
	55	20/20	16/18	No further improvement in the O/F.
1100	60	20/19	15/15	
	65	18/19	16/15	U/F looks good.
	70	18/18	16/16	
	75	18/18	16/16	
	80	19/19	16/18	

10

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Sept. 21, 1985 **TEST I.D.** P3 (Page 2)

FLOCCULANTS: [ALLIED COLLOIDS]

-CATIONIC Percol LT31

-ANIONIC Percol F10

ORDER OF FLOCCULANT ADDITION ANION + CATION

TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
85	19/20	15/16	
1130 90	19/20	16/16	
95	20/20	16/16	Washery went down at 1130 - Had to stop the test. (no more feed).
100	20/20	16/16	
105			
110			
115			
120			
125			
130			
135			
140			
145			
150			
155			
160			
165			

15

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Sept 21 **TEST I.D.** P4

FLOCCULANTS: [ALLIED COLLOIDS]

-CATIONIC Percol LT31

-ANIONIC Percol E10

ORDER OF FLOCCULANT ADDITION ANION + CATION

TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1215 0	0	10/10	
5	0	11/10	
10	0	11/11	Good flocculation much better than the last test (P3) this morning.
15	0	12/12	
20	0	10/11	
25	10/10	11/12	O/F - much better and improving.
1245 30	12/12	12/12	
35	20/22	12/11	
40	36/36	10/9	
45	46/46	9/10	
50	46	10/11	Excellent O/F clarity
55	46	11/11	
1315 60	46	11/10	
65	46	12/12	
70	40/40	16/16	Observed small change in O/F clarity (?).
75	40/44	16/18	
80	40/39	18/19	

lU

THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Sept. 21, 1985 **TEST I.D.** P4 (Page 2)

FLOCCULANTS: [ALLIED COLLOIDS]

-CATIONIC Percol LT31

-ANIONIC Percol E10

ORDER OF FLOCCULANT ADDITION ANION + CATION

TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
85	38/39	20/21	U/F looks better
1345 90	40/40	21/22	
95	46/46	22/21	
100	46	20/20	
105	46	20/22	O/F clarity back to 46 (This may be due to sudden charge in solids loading - solids in the feed looks high).
110	46	21/21	
115	46	22/21	
1415 120	46	20/21	
125	46	21/21	
130			Washery down - No more feed - had to stop the test run at 1425 - mobile plant feed is full with clean water (feed from the washery).
135			
140			
145			
150			
155			
160			
165			

15

THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Sept 21 **TEST I.D.** P5

FLOCCULANTS: [ALLIED COLLOIDS]

-CATIONIC Percol LT31

-ANIONIC Percol E10

ORDER OF FLOCCULANT ADDITION CATION + ANION

TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1520 0	0	11/11	Washery was down at about 1500 hr. - could not start the test earlier.
5	0	12/12	
10	0	2/9	
15	0	10/9	Good flocculation but no clarity and poor U/F.
20	0	14/14	
25	0	13/12	
1550 30	4/4	16/16	O/F looks better but still turbid.
35	4/4	18/20	
40	4/4	20/20	At 40 min.-both flocculant dosages were increased to 1.5 times by increasing the pump speed.
45	3/4	20/20	
50	14/14	20/21	
55	16/15	23/23	
1620 60	20/20	26/24	O/F - improved
65	26/26	24/24	
70	30/30	24/24	
75	30/31	28/30	
80	31/31	30/30	O/F and U/F improved - looks good.

THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Sept. 21 **TEST I.D.** P5 (Page 2)

FLOCCULANTS: [ALLIED COLLOIDS]

-CATIONIC Percol LT31

-ANIONIC Percol E10

ORDER OF FLOCCULANT ADDITION CATION + ANION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	85	36/36	30/30	
1050	90	40/40	30/31	
	95	46	30/30	Excellent O/F and U/F quality bed level remains unchanged at 34-36 inches.
	100	46	31/31	
	105	46	31/31	
	110	46	30/31	
	115	46	31/31	
1720	120	46/46	31/32	
	125			No feed - [washery down] test stopped.
	130			
	135			
	140			
	145			
	150			
	155			
	160			
	165			

THICKENER DATA SHEET

15

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Sept. 22/85 **TEST I.D.** P6

FLOCCULANTS: [ALLIED COLLOIDS]

-CATIONIC Percol LT31

-ANIONIC Percol E10

ORDER OF FLOCCULANT ADDITION CATION + ANION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1210	0	0	11/11	Too many interruptions in the feed supply due to the wash plant shutdown [between 0830 to 1130].
	5	0	15/14	
	10	0	14/14	
	15	0	13/14	
	20	0	15/15	
	25	0	14/14	
1240	30	0	20/20	
	35	0	23/24	Not much improvement in O/F clarity.
	40	4/4	24/24	
	45	6/7	23/23	
	50	6/7	24/24	Feed contains low solids - may be 2% or less: This was due to problem in the washery operation [no feed to washery for about 2-3 min.].
	55	7/7	24/23	
1310	60	10/10	23/23	
	65	11/12	20/21	
	70	15/15	22/22	
	75	20/20	23/23	
	80	20/20	23/23	

THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Sept. 22 **TEST I.D.** P6 (Page-2)

FLOCCULANTS: [ALLIED COLLOIDS]

-CATIONIC Percol LT31

-ANIONIC Percol E10

ORDER OF FLOCCULANT ADDITION CATION + ANION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	85	25/25	24/24	O/F clarity improved looks good.
1340	90	33/34	25/25	
	95	33/33	23/24	
	100	32/32	24/24	
	105	32/32	23/25	
	110	29/30	23/23	O/F & U/F looks better.
	115	30/30	25/25	
1410	120	30/30	26/25	
	125	30/30	26/26	
	130	30/29	26/26	
	135	30/30	27/27	Washery was down for about 10 min. The test was continued with the feed in mobile plant feed tank. Washery started and the test continued. Feed supply valve was closed during the washery shut down.
	140	30/31	25/24	
	145	33/33	24/24	
1440	150	35/34	24/24	
	155	35/35	26/26	
	160	39/40	26/26	
	165	40/40	26/26	

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Sept. 22 **TEST I.D.** P6 (Page -3)

FLOCCULANTS: [ALLIED COLLOIDS]

-CATIONIC Percol LT31

-ANIONIC Percol E10

ORDER OF FLOCCULANT ADDITION CATION + ANION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	170	46/46	27/20/26	
	175	46	25/24	
	180	46	24/24	
	185	39/40	26/25	Losing clarity - why? [may be high solids loading and too many fines]. O/F - not getting any better.
	190	40/40	24/26	
	195	38/36	27/25	
	200	30/30	27/28	
	205	42/40	26/27	
1540	210	46	26/26	O/F clarity back to 46 - looks good what happened at 185 min. [increased in feed concentration or change in feed characteristics].
	215	46	27/26	
	220	46	26/27	
	225	46	26/26	
	230			
	235			
	240			
	245			
	250			

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Sept. 22/85 **TEST I.D.** P7

FLOCCULANTS: [ALLIED COLLOIDS]

-CATIONIC Percol LT31

-ANIONIC Percol E10

ORDER OF FLOCCULANT ADDITION ANION + CATION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1700	0	0	12/12	
	5	0	15/15	
	10	0	15/14	Good flocculation observed
	15	0	16/16	
	20	4/6	19/20	
		4/4	20/21	
	25			
1730	30	10/10	22/22	O/F clarity improved in last 5 min.
	35	15/15	25/25	
	40	25/25	28/28	
		30/32	30/30	
	45			
	50	46	32/32	
	55	46	28/29	Excellent clarity.
1800	60	46	29/29	
	65	46	30/30	
	70	46	31/31	
	75	46	31/32	
	80	46	32/32	The test was stopped at 80 min.

THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Oct. 9/86 **TEST I.D.** H1

FLOCCULANTS: [HART & ALCHEM]

-CATIONIC 8852

-ANIONIC CRA-30

ORDER OF FLOCCULANT ADDITION CATION + ANION

TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1030 0	0	12	
5	0	8/9/9	
10	0	9/9/10	Poor flocculation
15	0	10/10/9	
20	0	9/9/10	
25	0	11/10/10	
1100 30	0	12/12/11	O/F getting better.
35	6/7/6	15/15/15	
40	10/10/10	15/15	Anionic dosages increased to double by increasing pump speed.
45	14/12/12	15/16	
50	14/15/15	17/16	
55	14/14/14	16/16	
1130 60	14/14/14	18/18	
65	18/18/16	18/18/18	
70	18/18/18	18/19	
75	22/22/21	22/22	
80	22/23/23	22/22	

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Oct. 9/86 **TEST I.D.** H1

FLOCCULANTS: [HART + ALCHEM]

-CATIONIC 8852

-ANIONIC CFA-30

ORDER OF FLOCCULANT ADDITION Cation + Anion

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	85	22/22	22/22	
1200	90	23/22	22/22	Anionic floc (CFA-30) dosages increased to double of Lab. optimum dosages.
	95	22/22	31/30	
	100	21/22	35/35	
	105	16/16	32/32	
	110	13/14	31/30	
	115	12/12	28/29	
1230	120	11/11	25/26	
	125	11/11	24/25	O/F - no improvement may need more cationic flocculant.
	130	11/11	24/24	
	135	11/11/11	25/25	
	140	11/11/11	25/25	
	145	11/11/11	24/24	
1300	150	11/11/11	25/26	Cationic flocculant (Alchem 2252) increased to double Same as Lab optimum dosages.
	155	11/12/12	25/25	
	160	12/12	25/25	
	165	11/11/12	25/25	

THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Oct. 9/85 TEST I.D. H1

FLOCCULANTS: [HART & ALCHEM]

-CATIONIC 8852

-ANIONIC CFA-30

ORDER OF FLOCCULANT ADDITION Cation + Anion

TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
170	11/12/12	25/25	
175	11/12/12	25/25	
1330 180	11/12/12	25/25	
185	14/14/13	25/25	
190	15/15/15	25/25	
195	17/16/16	25/25	Cation (Alchem 8852) dosages further increased to double - twice the Lab. optimum dosages.
200	17/17/17	25/26	
205	17/17	25/26	
1400 210	17/17	25/25	
215	18/19/18	26/25	
220	18/17/17	26/25	
225			
230			
235			
1430 240			
245			
250			

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Oct. 22/85 **TEST I.D.** H2

FLOCCULANTS: [HART & ALCHEM]

-CATIONIC 8852

-ANIONIC CFA-30

ORDER OF FLOCCULANT ADDITION Anion + Cation

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1330	0	0	6/7/7	Lot of problems in the feed supply frequent interuption
	5	0	7/7/7	
	10	0	6/6/6	
	15	0	7/7/6	
	20	0	7/7/7	Poor flocculation
	25	0	7/7/6	
1400	30	0	6/7/6	
	35	0	7/7/7	
	40	0	8/9/9	U/F pump tripped 2-3 min. stoppage in pumping the U/F Both flocculant dosages were increased to double (same as lab optimum dosages).
	45	0	9/10/9	
	50	10/10	10/10	
	55	14/13	11/10	
1430	60	15/15	11/11	
	65	17/16	16/16	
	70	17/17	16/17	O/F - looks better
	75	18/18	17/17	
	80	18/17	17/18	

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Oct. 22 **TEST I.D.** H2

FLOCCULANTS: [HART AND ALCHEM]

-CATIONIC 8852

-ANIONIC CFA-30

ORDER OF FLOCCULANT ADDITION ANION + CATION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	85	18/18	18/19	
1500	90	20/20	20/21	
	95	22/21	19/20	
	100	21/21	19/20	Both flocculant dosages were increased to double the Lab. optimum dosages.
	105	20/21	17/18	
	110	21/21	16/17	
	115	17/18	17/17	
1530	120	18/18	18/18	
	125	23/22	18/20	
	130	27/27	19/19	
	135	27/28	19/20	
	140	35/35	18/17	
	145	46/46	18/19	O/F clarity much improved.
1600	150	46	20/19	
	155	46	22/24	
	160	46	24/25	
	165	46	28/30	

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Oct. 22 **TEST I.D.** H2

FLOCCULANTS: [HART & ALCHEM]

-CATIONIC 8852

-ANIONIC CFA-30

ORDER OF FLOCCULANT ADDITION Anion + Cation

TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
170	46	29/30	
175	46	30/30	
1630 180	46	32/30	
185	46	30/30	
190	46	29/30	Excellent clarity U/F also looks good
195	46	30/31	
200	46	33/32	
205	46	31/32	
1700 210	46	32/32	
215			
220			
225			
230			
235			
240			
245			
250			

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Oct. 23/86 **TEST I.D.** H3

FLOCCULANTS: [HART AND ALCHEM]

-CATIONIC 8852

-ANIONIC CFA-30

ORDER OF FLOCCULANT ADDITION Cation + Anion

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1135	0	0	14/15	Could not get steady feed supply for the last 2 hours - had to discontinue the test twice
	5	6/6	13/14	
	10	9/10/9	14/15	
	15	12/12	15/15	
	20	13/13	16/16	
	25	14/14	15/16	Good flocculation
1205	30	13/13	14/16	
	35	13/13	22/23	O/F & U/F both look good.
	40	13/13	22/22	
	45	13/13	23/23	
	50	12/13/12	22/22	
	55	13/12	20/21	
1235	60	12/12	21/21	
	65	12/12	20/20	
	70	12/12	20/20	No change in O/F and U/F quality.
	75	12/12	20/19	
	80	12/12	20/20	

THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Oct. 23/80 **TEST I.D.** H3

FLOCCULANTS: [HART & ALCHEM]

-CATIONIC 8852

-ANIONIC CFA-30

ORDER OF FLOCCULANT ADDITION Cation + Anion

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	85	12/11	22/22	
1305	90	11/11	21/22	
	95	10/11	21/21	
	100	10/11	22/21	
	105	10/11	20/20	
	110	10/10	20/20	Not much improvement in O/F clarity (bit dirty).
	115	11/11/10	21/22	
1335	120	11/11	22/22	
	125	11/11	21/22	
	130	11/12	21/21	
	135	12/12	21/22	
	140	12/13	22/22	
	145	12/12	21/22	
1405	150	11/12	22/22	
	155	12/12	22/22	Stoppage in the feed supply - washery down continued with test to use up feed in the tank (1000 gal.)
	160	12/12	22/22	
	165	14/14	22/23	

THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Oct. 23 **TEST I.D.** H3

FLOCCULANTS: [HART & ALCHEM]

-CATIONIC 8852

-ANIONIC CFA-30

ORDER OF FLOCCULANT ADDITION Cation + Anion

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	170	14/14	20/21	
	175	12/12	20/20	
	180	12/12	22/22	Washery started feed supply resumed at 1430 hours. Had to stop the test run for 2-3 min. (because of low level in the feed tank).
1435	185	10/9	23/22	
	190	11/11	22/22	
	195	12/12	23/22	
	200	12/12	22/22	
	205	13/13	22/22	
1505	210	13/12	23/23	
	215	12/11	24/23	
	220	12/11	23/23	
	225	10/12	23/23	
	230	11/11	22/22	Cationic flocculant (8852) Dosages increased to double [14.4 g/t] U/F looks good.
	235	11/12	24/24	
1535	240	11/12	24/24	
	245	12/12	24/25	
	250	14/13	26/25	

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THICKENER DATA SHEET

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MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Oct. 23 **TEST I.D.** H3

FLOCCULANTS: [HART & ALCHEM]

-CATIONIC 8852

-ANIONIC CFA-30

ORDER OF FLOCCULANT ADDITION Cation + Anion

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	255	16/16	25/25	
	260	17/17	26/25	
	265	18/18	25/25	
1605	270	17/17	25/25	
	275	18/18	26/25	
	280	20/20	27/26	
	285	24/23	29/27	U/F looks high in solids
	290	26/26	29/29	
	295	26/25	28/29	
1635	300	25/25	29/29	O/F - excellent
	305	25/26	29/29	
	310	26/26	28/28	
	315	25/25	29/27	
	320	26/25	28/28	Not further improvement in the quality of O/F and U/F
	325	25/25	29/29	
1705	330	25/25	29/29	

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Oct. 24/85 **TEST I.D.** H4

FLOCCULANTS: [HART AND ALCHEM]

-CATIONIC 8852

-ANIONIC CFA-30

ORDER OF FLOCCULANT ADDITION Anion + Cation

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1430	0	0	15/15	
	5	5/4	16/15	
	10	9/10/9	15/15	Godd flocculation large flocs.
	15	20/21	14/14	
	20	20/20	14/15	
	25	25/25	15/16	Good clarity
1500	30	25/26	16/16	
	35	26/25	16/17	
	40	26/26	16/16	
	45	26/26	17/17	
	50	26/26	17/17	Not much improvement in the O/F clarity.
	55	27/26	18/18	
1530	60	27/26	18/19	
	65	29/29	21/22	
	70	29/30	22/22	
	75	30/31	23/23	
	80	30/30	23/23	

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Oct. 24 **TEST I.D.** H4

FLOCCULANTS:

-CATIONIC ______

-ANIONIC ______

ORDER OF FLOCCULANT ADDITION ______

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	85	30/30	24/24	
1600	90	30/30	24/25	
	95	30/30	25/25	
	100	29/30	26/25	
	105	30/29/29	27/26	No improvement in the O/F clarity.
	110	30/30	26/26	
	115	30/29	26/26	
1630	120	28/30	27/26	Feed looks bit higher in solids content. Marcy Scale shows an Increase of 2% [4.5 6.5%]
	125	30/29	26/27	
	130	29/30	27/27	
	135	30/30	27/28	
	140	30/30	27/27	
	145	30/30	27/26	
1700	150	29/30	26/26	
	155			
	160			
	165			

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: oct. 24/85 **TEST I.D.** H5

FLOCCULANTS: [HART AND ALCHEM]

-CATIONIC 8852

-ANIONIC CFA-30

ORDER OF FLOCCULANT ADDITION Cation + Anion

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1740	0	0	10/11	
	5	0	12/12	
	10	0	12/12	
	15	5/5	14/15	
	20	9/8	16/16	
	25	9/10	17/18	
1810	30	18/17	19/20	O/F clarity improved.
	35	20/20	20/21	
	40	20/21	19/18	
	45	21/22	18/17	
	50	22/23	18/19	
	55	22/23	20/21	
1840	60	24/24	21/22	No improvement in the O/F solids in U/F.
	65	24/24	22/22	
	70	24/24	19/20	
	75	24/24	21/20	
	80	24/25	21/22	Test stopped (assumed steady state achieved).

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THICKENER DATA SHEET

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MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Oct. 24/85 **TEST I.D.** H6

FLOCCULANTS: [HART AND ALCHEM]

-CATIONIC 8852

-ANIONIC CFA-30

ORDER OF FLOCCULANT ADDITION Anion + Cation

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1915	0	0	5/6	
	5	0	6/6	
	10	12/12	9/8/8	Excellent flocculation good clarity.
	15	20/20	7/6/6	
	20	25/25	10/12	
	25	35/37	11/11	
1945	30	40/40	12/12	Excellent clarity
	35	37/37	10/9	
	40	37/37	11/10	
	45	36/37	12/10	U/F does not look very thick.
	50	37/38	12/12	
	55	36/37	14/13	
2015	60	37/35	12/11	
	65	35/36	12/12	
	70	34/35	13/13	Clarity much better.
	75	35/35	12/12	
	80	35/35	12/13	

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Nov. 24 **TEST I.D.** D1 (Page-1)

FLOCCULANTS: [DIACHEM]

-CATIONIC

-ANIONIC 2890

ORDER OF FLOCCULANT ADDITION Only anionic flocculant was added

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1155	0	0	6/6/7	
	5	0	6/6/6	Feed look low in solids.
	10	0	6/7/6	
	15	0	7/6/6	Good flocculation
	20	0	6/6/7	
	25	6/7	7/7/6	
1225	30	6/6/7	7/7/8	O/F clarity looks good.
	35	9/10/9	7/7/8	
	40	10/10	7/6/8	
	45	10/10	7/7/8	Flocculant dosages was increased to double by increasing the pump speed.
	50	10/11/10	7/7/8	
	55	12/12/13	7/7/7	
1255	60	15/15/16	8/7/8	Bit improvement in O/F clarity
	65	20/20	7/7/8	
	70	22/23	7/8/8	Feed looks dilute (2% on marcy scale.)
	75	23/25	7/9/8	
	80	23/22	7/8/8	Flocculant dosages increased to 3 times.

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Nov. 24 **TEST I.D.** D1 (Page-2)

FLOCCULANTS: [DIACHEM]

-CATIONIC ____________

-ANIONIC 2890

ORDER OF FLOCCULANT ADDITION ____________

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	85	23/23	9/9/10	
1325	90	23/22	10/9/9	
	95	24/25/25	9/10/9	
	100	46	9/10/10	O/F clarity - Excellent
	105	46	11/11/12	
	110	46	12/12/13	Feed (2-3% solids)
	115	46	12/13/12	
1355	120	46	14/14/15	
	125	46	15/15/14	U?F? looks much better
	130	46	17/17/18	
	135	46	19/19/18	
	140	46	18/17/17	
	145	46	17/18/18	
1425	150	46	16/16/18	
	155	46	18/17/17	
	160	46	18'18/18	Excellent clarity and thickening.
	165	46	19/18/19	

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Nov. 24/85 **TEST I.D.** D1 (Page-3)

FLOCCULANTS: [DIACHEM]

-CATIONIC ______

-ANIONIC 2890

ORDER OF FLOCCULANT ADDITION ______

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	170	46	18/18/19	
	175	46	18/19/18	Test discontinued
1455	180	46	18/19/19	
	185			
	190			
	195			
	200			
	205			
	210			
	215			
	220			
	225			
	230			
	235			
	240			
	245			
	250			

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Nov. 24 **TEST I.D.** D2

FLOCCULANTS: [DIACHEM]

-CATIONIC 4421

-ANIONIC ______

ORDER OF FLOCCULANT ADDITION Only cationic flocculant was added.

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1635	0	0	6/7/7	
	5	0	7/7/7	Feed-low solids
	10	0	7/7/8	
	15	0	6/7/7	No clarity but getting better.
	20	0	7/7/8	
	25	0	7/8/8	
1705	30	0	7/6/7	Flocculant dosages increased to double
	35	0	8/7/8	
	40	10/10	7/7/8	U/F-(poor) no improvement.
	45	15/15/17	7/7/7	
	50	20/19/20	7/8/8	
	55	46/46	8/7/7	
1735	60	46	10/11	
	65	46	10/11/12	
	70	46	7/6/6	Excellent clarity.
	75	46	7/7/6	
	80	46	7/8/7	

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Nov. 24 **TEST I.D.** D2

FLOCCULANTS: [DIACHEM]

-CATIONIC 4421

-ANIONIC ________

ORDER OF FLOCCULANT ADDITION ________

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	85	46	7/8/8	Feed contains low solids = 2%.
1805	90	46	9/8/8	
	95	46	7/7/7	
	100	46	7/7/7	
	105	46	6/7/7	No further improvement Test discontinued.
	110			
	115			
	120			
	125			
	130			
	135			
	140			
	145			
	150			
	155			
	160			
	165			

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THICKENER DATA SHEET

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MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Nov. 25 **TEST I.D.** D3

FLOCCULANTS:

-CATIONIC 4421

-ANIONIC 2890

ORDER OF FLOCCULANT ADDITION CATION + ANION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1435	0	0	14/13	Frequent interruption in feed supply all morning.
	5	0	13/13	
	10	10/10	12/13/13	
	15	10/11	15/15/14	O/F and U/F both look good.
	20	10/10/10	15/16/15	
	25	9/10/10	17/17/16	
1505	30	11/11/12	21/20/20	
	35	13/13/13	22/22/21	
	40	13/12/12	21/21/21	Flocculant dosages were increased to double by increasing the pump speed.
	45	13/12/13	20/20/21	
	50	13/13/12	19/19/20	
	55	13/13/12	18/19/19	P6 (underflow pump) was tripped (about 3 min.).
1535	60	13/13/13	20/20/21	Not much improvement in U/F and O/f.
	65	13/13/12	17/18/20	
	70	14/14/14	17/15/17	
	75	15/16/16	16/17/17	
	80	16/16/16	18/18/17	Cationic flocculant dosages was increased to 3 times.

10

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Nov. 25 **TEST I.D.** D3

FLOCCULANTS:

-CATIONIC 4421

-ANIONIC 2890

ORDER OF FLOCCULANT ADDITION CATION + ANION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	85	15/15/14	25/26/26	
1605	90	30/31/31	27/27/29	
	95	46/46	26/28/28	No feed from the washery - Test stopped at 125 min. had enough feed in the feed tank to continue for 15 min.
	100	46	28/29/29	
	105	46	30/28/28	
	110	46	30/30/30	
	115	46	31/30/31	
1635	120	46	31/32/31	
	125	46	31/30/32	Washery may be down for about 2-3 hours.
	130			
	135			
	140			
	145			
	150			
	155			
	160			
	165			

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THICKENER DATA SHEET

15

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Dec. 10/85 **TEST I.D.** D4

FLOCCULANTS:

-CATIONIC 4421

-ANIONIC 2890

ORDER OF FLOCCULANT ADDITION CATION + ANION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
0940	0	0	10/11/11	Feed = 2-3% Marcy scale.
	5	0	11/12/11	
	10	6/5/6	13/12/13	Good flocculation
	15	17/18/17	13/14/14	O/F looks good.
	20	30/30	14/16/16	
	25	46/46	17/16/16	Excellent clarity
1020	30	46	19/19/20	
	35	46	19/19/19	
	40	46	19/20/20	
	45	46	20/20/19	Pump P6 trupped [about 5 min. - wo start the pump].
	50	46	20/20	
	55	46	21/21/21	
1040	60	46	21/21/21	
	65	46	21/21/20	
	70	46	21/22/22	U/F and O/F both look excellent.
	75	46	21/22/22	
	80	46	23/22/22	Pump P6-tripped again [2-5 minutes].

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Dec. 10 TEST I.D. D4 Page-2

FLOCCULANTS:

-CATIONIC 4421

-ANIONIC 2890

ORDER OF FLOCCULANT ADDITION CATION + ANION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	85	40/41	23/23/23	
1120	90	43/43	23/22/22	Feed 2-3% solids
	95	43/43	22/23/21	
		46/46	24/22/22	
	100	46	23/23/22	
	105	46	22/21/22	
	110	46	23/22	
1140	115	46	23/22	
	120	46	24/24	
	125	46	24/25	
	130	46	24/24/24	Excellent O/F and U/F - Test discontinued.
	135			
	140			
	145			
	150			
	155			
	160			
	165			

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15

THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Dec. 10/85 **TEST I.D.** D5

FLOCCULANTS: [DIACHEM]

-CATIONIC 4421

-ANIONIC 2890

ORDER OF FLOCCULANT ADDITION ANION + CATION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1345	0	0	6/7/6	Flocculant dosages ½ of optimum dosages
	5	0	6/7/6	
	10	0	6/6/6	Poor flocculation
	15	0	6/6/7	
	20	0	6/5/6	Feed looks good = 4-5% solids.
	25	0	7/7/7	
1415	30	0	7/8/7	
	35	6/7/6	7/8/8	
	40	7/7/7	9/9/8	
	45	7/9/9	9/9/9	Increased anionic flocculant dosages to 1.5 times.
	50	10/10	7/8/8	
	55	20/22	8/8/8	U/F quality looks low in solids.
1445	60	24/23/22	9/8/9	
	65	24/25	8/8/8	
	70	35/35	9/9/8	
	75	46/46	2/9/9	Excellent O/F clarity.
	80	46/46	8/8/9	

U

THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Dec. 10/85 **TEST I.D.** D5 (Page-2)

FLOCCULANTS: [DIACHEM]

-CATIONIC 4421

-ANIONIC 2890

ORDER OF FLOCCULANT ADDITION ANION + CATION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	85	46	8/7/8	
1515	90	46	7/7/7	Anionic flocculant dosages were increased to twice by increasing the pump speed.
	95	46	7/8/8	
	100	46	9/10/9	
	105	46	9/9/9	
	110	46	10/10/10	
	115	46	11/11/10	
1545	120	46	12/10/12	Not significant improvment in U/F - still looks poor.
	125	46	10/9/11	
	130	46	10/10/10	
	135	46	9/9/10	
	140	46	10/10/11	
	145	46	11/12/12	
1615	150	46	12/12/12	Anionic flocculant (2890) dosages was further increased (2.5 litres)
	155	46	14/14/14	
	160	46	12/13/12	
	165	46	13/13/12	

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Dec. 10/85 **TEST I.D.** D5

FLOCCULANTS: [DIACHEM]

-CATIONIC 4421

-ANIONIC 2890

ORDER OF FLOCCULANT ADDITION ____________

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	170	46	13/13/13	
	175	46	15/15/14	
1645	180	46	14/15/15	U/F - improved
	185	46	15/16/15	
	190	46	16/16/16	
	195	46	16/16/15	No feed from Washery stopped test at 210 min - had enough feed to continue for 20 minutes.
	200	46	16/16	
	205	46	16/16	
1715	210	46	16/16	
	215			
	220			
	225			
	230			
	235			
	240			
	245			
	250			

15

F-166

THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Dec. 11/85 **TEST I.D.** D6

FLOCCULANTS:

-CATIONIC 4421

-ANIONIC 2890

ORDER OF FLOCCULANT ADDITION ANION + CATION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1000	0	0	8/8/7	Feed looks good about 4-5% (Marcy Scale)
	5	0	7/8/7	
	10	0	8/8/7	
	15	0	8/8/8	
	20	0	10/10/10	Some clarity
	25	0	11/10/11	U/F - looks poor
1030	30	10/8	9/10/10	
	35	12/11	11/11/10	
	40	12/11	9/10/10	O/F - improved
	45	10/10	10/11/11	
	50	10/10	11/12/12	
	55	16/16	11/12/12	
1100	60	15/15	12/12/12	O/F - better
	65	16/16	12/12/13	
	70	16/16	10/11/11	U/F - Not much improvement
	75	18/18	9/10/10	
	80	19/20	11/11/11	

10

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Dec. 11/85 **TEST I.D.** D6

FLOCCULANTS:

-CATIONIC 4421

-ANIONIC 2890

ORDER OF FLOCCULANT ADDITION ANION + CATION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	85	24/20	10/11/11	
1130	90	30/30	12/12/11	Pump P6 - tripped [2-3 minutes].
	95	35/36	11/12/12	
	100	37/37	10/11/11	O/F - looks excellent
	105	46	12/12/12	
	110	46	12/13/13	U/F - bit better
	115	46	14/14/14	
1200	120	46	14/14/15	
	125	46	15/15/15	
	130	46	16/16/17	
	135	46	17/17/17	
	140	46	18/18/17	U/F - improved but not much overall improvement - Test discontinued
	145	46	20/21/21	
1230	150	46	22/22/23	
	155			
	160			
	165			

15

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Sept. 23/85 **TEST I.D.** C1

FLOCCULANTS: [CALGON]

-CATIONIC M502

-ANIONIC L691E

ORDER OF FLOCCULANT ADDITION CATION + ANION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1040	0	0	10/10	
	5	0	10/9	
	10	0	11/10	
	15	0	11/11	
	20	0	12/12	O/F improving
	25	5/5	16/16	
1110	30	7/7/8	18/18	
	35	7/7/7	20/20	
	40	9/10/10	19/19	Underflow pump [P6] tripped - stopped for about 2 minutes.
	45	24/25	18/19	
	50	23/24/24	20/20	
	55	23/22/23	21/22	O/F and U/F quality much improved, looks good.
1140	60	23/23/23	20/20	
	65	22/21/22	20/20	
	70	22/24/24	20/21	
	75	23/23/22	21/21	
	80	24/23/24	21/21	

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Sept. 23/85 **TEST I.D.** C1

FLOCCULANTS: [CALGON]

-CATIONIC M502

-ANIONIC L691E

ORDER OF FLOCCULANT ADDITION CATION + ANION

TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
85	24/24	20/20	Used up all the feed in the feed tank.
90	24/24	20/20	
95	25/25	20/20	No feed - washery down at 12:00 pm
100			
105			
110			
115			
1240 120			
125			
130			
135			
140			
145			
150			
155			
160			
165			

15

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Sept 23/85 **TEST I.D.** C2

FLOCCULANTS: [CALGON]

-**CATIONIC** M502

-**ANIONIC** L691E

ORDER OF FLOCCULANT ADDITION CATION + ANION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1435	0	0	11/11	Frequent interruptions in the feed supply.
	5	0	11/11	
	10	6/7/7	11/12/12	Washery down between 12 to 12:35 PM - down again 1 PM for an hour.
	15	7/7	16/16	
	20	9/9	18/18	
	25	11/12/12	20/20	
1505	30	9/10/10	21/21	
	35	15/15	20/20	
	40	14/14	20/20	
	45	20/20	20/20	
	50	21/21/22	20/20	
	55	22/21/22	22/22	
1535	60	21/21	22/22	O/F much improved.
	65	21/21	21/22	
	70	22/22	22/22	
	75	21/21	22/22	
	80	22/22	22/22	

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Sept. 23/85 **TEST I.D.** C2

FLOCCULANTS: [CALGON]

-CATIONIC M502

-ANIONIC L691E

ORDER OF FLOCCULANT ADDITION CATION + ANION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	85	22/22	21/21	
1605	90	22/22	21/21	
	95	22/22	21/21	Washery down Test discontinued.
	100			
	105			
	110			
	115			
	120			
	125			
	130			
	135			
	140			
	145			
	150			
	155			
	160			
	165			

15

F-172

THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Sept. 24/85 **TEST I.D.** C3

FLOCCULANTS: [CALGON]

-CATIONIC M502

-ANIONIC L691E

ORDER OF FLOCCULANT ADDITION CATION + ANION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1335	0	5/5	10/11	Washery down most of the morning.
	5	5/5	12/12	
	10	7/7/8	15/16/15	
	15	15/15	17/17	Good flocculation O/F clarity looks very good.
	20	20/20	19/19	
	25	22/22	18/19/19	
1405	30	24/24	19/19	
	35	22/22	19/19	Washery was down for 2 minutes - Test continued with feed in feed tank.
	40	22/21/22	21/21	
	45	25/25	20/20	
	50	24/24	20/20	
	55	27/27	20/20	
1435	60	27/27	21/21	
	65	26/26	20/21	
	70	27/27	22/22	
	75	27/27	23/23/24	No further improvement Test stopped
	80	28/28	24/24	

15

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Sept. 24 **TEST I.D.** C4

FLOCCULANTS: [CALGON]

-CATIONIC M502

-ANIONIC L691E

ORDER OF FLOCCULANT ADDITION ANION + CATION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1815	0	0	28/28	
	5	0	27/28	Excellent U/F
	10	0	26/26	
	15	0	28/28	O/F improving
	20	7/7/7	26/26	
	25	7/8/7	26/26	
1845	30	15/14/15	27/26/27	O/F looks very good.
	35	19/20/20	27/27	
	40	20/20	27/27	
	45	21/22/22	26/28	
	50	22/22/23	28/28	
	55	23/23	28/27	Not much improvement in O/F and U/F
1915	60	22/23/22	27/27	Test discontinued No feed - washery down.
	65	22/22	27/27	
	70			
1930	75			
	80			

15

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Oct. 6/85 **TEST I.D.** C5

FLOCCULANTS: [CALGON]

-CATIONIC M502

-ANIONIC L691E

ORDER OF FLOCCULANT ADDITION ANION + CATION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1530	0	0	19/20	Washery down most part of the morning.
	5	0	24/23	
	10	0	25/26	Good flocculation
	15	4/4/5	29/29	U/F looks high in solids content.
	20	10/9/10	29/29	
	25	8/7/8	28/27	
1600	30	8/8/8	26/26	
	35	15/15	27/27	
	40	15/16/15	29/29	
	45	18/18	30/31	
	50	17/18/17	29/30	
	55	18/18	28/28	
1630	60	19/19	29/28	
	65	25/26/25	28/28	
	70	27/27	29/29	Not much improvement in O/F and U/F.
	75	28/28	27/26	
	80	28/28	28/28	

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Oct. 6/85 TEST I.D. C5

FLOCCULANTS: [CALGON]

-CATIONIC M502

-ANIONIC L691E

ORDER OF FLOCCULANT ADDITION ANION + CATION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	85	29/28/29	28/27	
1700	90	29/30/30	27/27	
	95	35/35	28/28	
	100	38/37/38	27/27	
	105	42/42	29/28	
	110	46/46	28/28	O/F - excellent
	115	46	27/28	
1730	120	46	28/27	
	125	46	29/29	
	130	46	28/27	
	135	46	28/28	Test discontinued
	140			
	145			
1800	150			
	155			
	160			
	165			

15

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: Oct. 6/85 **TEST I.D.** C6

FLOCCULANTS: [CALGON]

- CATIONIC M502
- ANIONIC L691E

ORDER OF FLOCCULANT ADDITION ANION + CATION

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1835	0	0	10/11/11	
	5	0	11/11	Good flocculation.
	10	10/10	9/10/9	
	15	12/12/11	8/8/9	
	20	12/12	9/9/9	
	25	20/19/20	9/8/9	O/F much improved Washery was down for about 1-2 min., test continued with feed in the tank.
1905	30	25/24/25	12/12	
	35	30/30	15/14/15	
	40	38/38	19/19	
	45	46/46	21/21	
	50	46	20/20	O/F - excellent.
	55	46	20/21/20	
1935	60	46	22/22	
	65	46	23/22	
	70	46	22/22	
	75	46	20/21	
1955	80	46	22/22	O/F and U/F excellent Test discontinued.

THICKENER DATA SHEET

15

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: June 10/85 **TEST I.D.** A1-A3

FLOCCULANTS: [ALCHEM]

-CATIONIC ____

-ANIONIC 8C26

ORDER OF FLOCCULANT ADDITION only anionic flocculant was added.

TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
1505 0	0	6/5	Feed, O/F & U/F samples collected at 1505 (every 15 min.)
5	0	6/6	
10	0	6/7	
15	0	7/8	
20	0	8/8	Samples collected at 1520.
25	0	8/8	
1535 30	0	7/6	
35	0	7/7	Samples collected at 1535 no improvement in O/F and U/F quality.
40	0	7/8	
45	0	8/8	
50	0/3	7/6	
55	3/3	7/7	O/F bit better
1605 60	5/5	7/6	No improvement
65	4/5	7/6	
70	5/5	8/8	
75	5-5	8/8	End of test A1 At 1620 the flocculant dosages was increased to 40.8 g/t by increasing pump speed. (start of Test A2).
80	5/5	7/8	

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THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: June 10/85 **TEST I.D.** A1-A3

FLOCCULANTS: [ALCHEM]

-**CATIONIC** ____________

-**ANIONIC** 8C26

ORDER OF FLOCCULANT ADDITION only anionic flocculant was added.

	TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
	85	4/4	7/7	The feed looks low in solids.
1635	90	7/6	7/8	
	95	7/6/6	8/9	
	100	8/7	10/12	O/F looks better.
	105	8/8	12/14	
	110	10/10	11/12	
	115	10/10	11/12	
1705	120	10/10	12/13	
	125	10/10	13/12	
	130	10/10	13/13	At 1720 the flocculant dosages was increased to 81.6 g/t by increasing the pump speed.
	135	10/10	12/12	
	140	17/18	12/11	
	145	26/25	13/12	Test A3 begins at 1720.
1735	150	23/22	13/15	
	155	22/22	13/14	O/F much improved.
	160	23/23	14/14	
	165	21/22	14/15	

5

THICKENER DATA SHEET

MOBILE WATER TREATMENT PLANT TEST WORK AT OBED WASHERY

DATE: June 10/85 **TEST I.D.** A1-A3

FLOCCULANTS: [ALCHEM]

-**CATIONIC** ____________

-**ANIONIC** 8C26

ORDER OF FLOCCULANT ADDITION only anionic flocculant was added.

TIME (min)	O/F CLARITY (ALCHEM WEDGE)	% SOLIDS IN TH. U/F (MARCY SCALE) Spec. Gravity	GENERAL COMMENTS & OBSERVATIONS
170	22/22	15/15	
175	22/22	16/15	O/F and U/F looks much better
1805 180	23/22	18/18	Feed looks low in solids.
185	22/22	18/18	
190	22/23	17/15	
195	22/22	17/17	End of Test - A3.
200			
205			
210			
215			
220			
225			
230			
235			
240			
245			
250			